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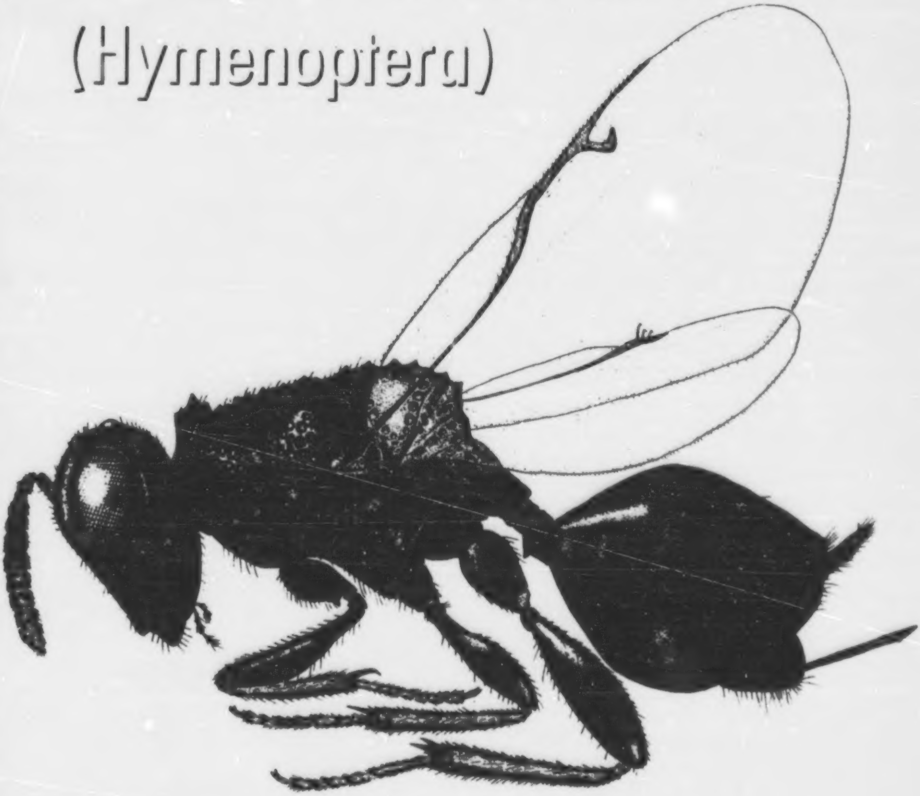
Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera)



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Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera)

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Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera)

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Abstract

This multiauthored publication presents illustrated keys to the 19 families and 706 described genera of Chalcidoidea known to occur in the Nearctic region. There are about 330 differences between the genera keyed and those listed in the most recent (1979) North American catalog, including about 200 additional genera. The book consists of 22 chapters by 17 world experts, plus an appendix of about 130 generic names no longer considered valid for the region, and separate indexes to chalcidoid names, animal hosts, and plant hosts. The first three chapters provide an introduction, review of chalcidoid structure, and an overview of the superfamily, including a 41 couplet key to families. Each of the remaining 19 chapters reviews one family and includes introductory sections on its recognition, systematics and relationships, biology, literature, an annotated key to the Nearctic genera, and for larger families an index to genera based on couplet number. Over 1,800 line drawings and scanning electron micrographs illustrate the keys. The annotations include references to existing keys to species, estimated number of species, and known distribution and host range in the region.

Résumé

Cette publication collective offre les clés illustrées des 19 familles des chalcidiens ainsi que de leurs 706 genres que l'on retrouve dans la région néarctique. Il y a environ 330 différences entre le recensement des genres de cette publication et celui du plus récent registre nord-américain (1979), y compris 220 genres additionnels. Le recueil, constitué de 22 chapitres signés par 17 experts reconnus de par le monde, comprend un appendice qui rend compte de 130 noms génériques qui ne sont plus admis pour la région ainsi que des index distincts des noms des chalcidiens, des animaux-hôtes et des plantes-hôtes. Les trois premiers chapitres offrent respectivement une introduction, un survol de la structure des chalcidiens et une vue d'ensemble de la superfamille, y compris une clé des familles à 41 paires. Chacun des 19 chapitres suivants portent sur une famille et comprend une section d'introduction sur son identification, sa taxinomie et ses relations, sa biologie, sa documentation ainsi qu'une clé annotée des genres néarctiques et, dans le cas des familles plus importantes, un index des genres par numéro de paire. Les clés sont illustrées à l'aide de 1800 dessins au trait et micrographies électroniques à balayage. Les annotations comprennent des rappels aux clés existantes des espèces, le nombre d'espèces évalué et la distribution connue ainsi que la gamme d'hôtes dans la région.

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Chapter 1. INTRODUCTION

John T. Huber

There is an increasing awareness by the public and governments that ecologically sound and environmentally safe methods of pest control are more desirable than use of synthetic insecticides, both to prevent further environmental degradation and to enhance control of many pests. This awarness has had an important bearing on taxonomy. Included among the 'alternative' methods of pest control is biological control, historically one of the best alternatives to chemical control. For example, introduction of a single encyrtid species into Texas to control rhodesgrass mealybug, at an initial outlay of not more than $0.2 million, has resulted in successful control worth at least about $200 million yearly to the Texas cattle and turf industry (Dean et al. 1979). Clausen (1978), DeBach and Rosen (1991), LaSalle (1993), and Noyes (1994) provide other examples of control and substantial savings in North America and elsewhere using biological control. However, biological control is dependent to a considerable extent for success on correct identifications of both pests and their parasites or predators (Miller and Rossman 1995). Hence the need for taxonomists who can provide quick and accurate species identifications. The purpose of this manual is to permit identification of the described genera of Nearctic Chalcidoidea by means of illustrated and annotated keys.

Until recently the large and economically important but taxonomically difficult superfamily Chalcidoidea (chalcidoid wasps or chalcids), most of whose members are parasites of other insects, had received relatively little attention by taxonomists in North America. The major milestone in Nearctic chalcidology during the latter half of the 20th century is perhaps the catalog by Peck (1963). Also important is the section on Chalcidoidea in the synoptic catalog of Hymenoptera of America North of Mexico by Peck (1951), supplemented by Burks (1958, 1967), and similar sections by Burks (1979*a, b*), Gordh (1979), and Grissell (1979) in the Catalog of Hymenoptera in America North of Mexico (Krombein et al. 1979). Unfortunately, taxonomic study of Chalcidoidea did not keep pace with the cataloguing endeavors. Yoshimoto (1984) keyed the families and some subfamilies of Canada, and Grissell and Schauff (1997) provided an excellent illustrated key to the families and many subfamilies of the Nearctic region. However, it has been difficult, if not impossible, to identify correctly and reliably to genus a considerable proportion of the 489 genera (about 2,007 described species) of the cataloged Nearctic Chalcidoidea. A more recent check list of North American Hymenoptera listed 2667 valid species of Chalcidoidea in 568 genera (Poole and Gentili 1996).

Until now, workers studying Chalcidoidea often had to rely on foreign literature for generic identification of Nearctic chalcidoids. The genera of many families, Pteromalidae, Eulophidae and Encyrtidae in particular, could only be identified using such works as Bouček and Hoffer in Peck et al. (1964), Graham (1969), and Noyes (1980) [in addition to the Nearctic encyrtid key by Trjapitzin and Gordh (1978*a*, *b*)]. These works, of course, cover only part of the Nearctic fauna and consequently were only partly reliable. Furthermore, some genera and many species new to science still await description and most previously described species require proper redescription to be identifiable. The lack of a sound taxonomic base continues to retard other scientific research using chalcidoids (LaSalle 1993, LaSalle and Gauld 1992, Noyes 1994).

Production of a one-volume set of keys to the genera of Nearctic Chalcidoidea was first proposed by Z. Bouček, the world's foremost chalcidologist, during a meeting of parasitic hymenopterists in Gainesville, Florida, in 1987. His proposal was prompted by the relatively large number of student chalcidologists then being trained or who had recently graduated from North American universities. Following this initial proposal, several students and professionals continued to develop the idea of publishing an identification manual to the genera. Funding was obtained from the Canadian Forest Service for Dr. Bouček to study the Pteromalidae in the Canadian National Collection of Insects and Arachnids (CNC) for about 8 months in 1989, 1991 and, with funds from Agriculture Canada, in 1993. During his first visit a meeting of 13 chalcidologists was held in Ottawa to implement the project formally and discuss format and content of the proposed manual. Two additional chalcidologists, Dr. L. De Santis from Argentina and Dr. G. Delvare from France, also attended as observers. Finally, Dr. J. Woolley obtained a U.S. National Science Foundation grant to fund several of the contributors, some of whom could not otherwise have participated in the project.

The geographic scope of the manual covers, minimally, America north of Mexico but many chapters cover the Nearctic biogeographical realm, composed of Canada, continental USA, and those areas of Mexico generally considered as having a Nearctic insect fauna. Depending on the author, Greenland and part or most of the Nearctic areas of Mexico (usually considered to include the mountainous areas and central plateau south to the gulf of Tehuantepec but excluding coastal areas) may also be included. Where necessary the authors define more precisely the area of Mexico covered. Standard two letter postal abbreviations are used for the states of USA and provinces of Canada (Table I). Mexican states are written in full. All previously described valid genera known to occur in the Nearctic region (as defined by the authors) are included; those found to be new to science were described separately (Bouček 1993*a*, *b*; Coote

1994; Gibson 1995; Grissell 1993; Heydon 1994; Heydon and Bouček 1992; Huber 1993; LaSalle 1994; LaSalle and Schauff 1994; Noyes and Woolley 1994; Schauff and LaSalle 1993) so that no new taxa are proposed in the keys. This manual thus provided a significant impetus to increase our knowledge of the Nearctic chalcidoid fauna.

Two chapters cover, respectively, chalcidoid morphology as related to terms used in the keys and diagnoses, and the superfamily Chalcidoidea with a pictorial key to the families. Each of the 19 families is treated in its own chapter, which includes a differential family diagnosis and salient information on biology and literature. Brief annotations are given for most genera, including reference to published keys to species in the region, number of Nearctic species (and world species for some families), distribution, and hosts when known. Unless stated otherwise, it can be assumed that the chalcidoid is a primary parasite of the host mentioned. The term parasite is used instead of parasitoid for simplicity. It is implicit that insect parasites are not parasites in the true sense. Important references and, for families with more than 10 couplets, an index to chalcidoid names based on couplet number are also included. About 1,880 illustrations, an appendix of genus-group name changes since Krombein et al. (1979), and three indexes — one for generic names for chalcidoids, one for their animal hosts, and one for their plant hosts and associates, complete this work.

Although this manual represents a considerable advance in our knowledge of Nearctic chalcidoids there are still problems to be resolved, such as redefining generic limits in many families and providing a better higher classification, i.e., determining monophyly and relationships of families and grouping genera meaningfully into tribes and subfamilies. Much of this kind of research awaits careful revisionary study of the relatively numerous genera or groups of apparently related genera that have never been revised. Different contributors may have provided a phylogenetic interpretation for the families they treat. Their ideas sometimes contradict each other. As editors, we have not attempted to harmonize the views of different authors partly because it is not the purpose of this manual to provide rigorous phylogenetic hypotheses about familial relationships, but largely, and more to the point, because solid evidence is lacking for accepting one hypothesis over another. Because of differences among the families, and the circumstances and preferences of the authors, we have also not attempted to make all chapters completely consistent in format and presentation. Despite these deficiencies, for the first time this manual will permit many people, both non-taxonomists and taxonomists (including chalcidoid taxonomists themselves) to identify reliably to genus most Nearctic chalcidoids. It is expected that this manual will be widely used by biological control workers, economic entomologists in agriculture and forestry, those doing biological surveys, curators of insect collections, and workers in other scientific and technical disciplines that rely on the results of taxonomic research. This in turn should increase interest in the superfamily from both the basic biological and the applied biological control viewpoints. In the longer term, it should facilitate revisionary studies of selected chalcidoid genera of particular economic importance.

A relatively large number of North American students of Chalcidoidea were trained during the past two decades. They were able to study groups of interest to them and their selection of families for study covered almost the entire superfamily with very little overlap. Dr. Bouček, meanwhile, continues to work actively on Chalcidoidea even though he is retired (Šedivý 1994). He thus had the time and willingness to apply his unrivalled expertise to several families that were not adequately covered by North American specialists. Finally, funding for the project was forthcoming at a time when researchers had greater freedom and fewer monetary or bureaucratic constraints to choose topics for study. This fortuitous combination of factors provided a narrow window of opportunity that allowed this manual to be produced. However, given present-day constraints it is unlikely that such an opportunity will occur again in the foreseeable future, despite the general importance of systematics to biology.

Brief History of Chalcidology in North America

Two early taxonomists from outside the United States described a moderate number of Nearctic chalcidoids. F. Walker (1843–1871) in England described 72 species (Burks 1975) and L. Provancher (1981–1888) in Canada described 49 species (Burks 1963). Numerous genera with Holarctic distribution were, of course, described by European workers in the 1800's (Fig. 1).

In North America many people contributed to describing or revising the chalcidoid fauna. Some described only one or a few species; others spent a career working on one or two families or perhaps only one or two large genera. Many of the principal contributors to Nearctic chalcidoid taxonomy are listed below. The remainder are mostly referenced in the family chapters.

The history of chalcidoid research in North America was, until fairly recently, largely that of researchers who had spent part or all of their careers employed by the U.S. Department of Agriculture and stationed at the National Museum of Natural History (USNM), Washington, D.C. The principal taxonomists and the range of dates when they published on chalcidoids (not only while employed at the USNM) are listed here. In the 1800's and early 1900's the main workers were C.V. Riley (1880–1895), L.O. Howard (1881–1929) and W.H. Ashmead (1880–1904). Ashmead (1904) summarized the accumulated taxonomic knowledge at the generic level in a world key. Following Ashmead were J.C. Crawford (1907–1921), A.A. Girault (1905–1929), A.B. Gahan (1909–1951), B.D. Burks (1952–1977) and G. Gordh (1973–1985). The current chalcidologists at the USNM are E. Grissell and M. Schauff, both employed by the U.S. Department of Agriculture.

Although there has been a continuous succession of chalcidoid taxonomists at the USNM since Ashmead, it was not until 1935 that Agriculture Canada hired O. Peck for the CNC in Ottawa. He worked initially as an insect pest investigator, but published on chalcidoids from 1963–1985. He was succeeded by C. Yoshimoto, employed by the Canadian Forest Service (CFS), who worked almost entirely on chalcidoids (1970–1994). The current researchers at the CNC are G. Gibson, employed by Agriculture and Agri-Food Canada, and J. Huber, employed by the CFS. Mexico did not have a professional chalcidologist until 1985 when A. Gonzalez H. was employed at the Universidad Autonoma de Nuevo Leon, Monterrey.

Taxonomic work was also done by biological control workers, who usually could not devote their time entirely to taxonomy. R.L. Doutt, University of California, Berkeley, published on Trichogrammatidae and Mymaridae (1947–1973). Three researchers at the University of California, Riverside, published extensively on Aphelinidae and Encyrtidae: P.H. Timberlake (1910–1924), H. Compere (1924–1961), and P. DeBach (1939–1981). Some of the largest chalcidoid genera were treated by researchers in various institutions in the United States. R.E. Bugbee (1936–1982), last at Allegheny College, Pennsylvania, contributed significantly to the Eurytomidae, especially *Eurytoma* (1967), W. Balduf, University of Illinois, Urbana, treated *Sycophila* (1932), L. Huber, Ohio Agriculture Experiment Station, treated *Torymus* (1927), and M. Smulyan, Bureau of Entomology, U.S. Department of Agriculture treated *Perilampus* (1936).

The mid-1970's represented a turning point for North American chalcidology, partly because of the development and greater use of new techniques. The critical point drier became an important part of preserving collected material, which up to then was often in very poor condition for study (many chalcidoids shrivel badly when air dried). Use of the scanning electron microscope also became invaluable for interpreting and illustrating structure. Better techniques for collecting, preparing, and storing large numbers of specimens in good condition also were popularized (e.g., Noyes 1982, 1990).

Between 1930 and 1975 there were effectively only two professionals working full time on chalcidoid taxonomy. The 1980's saw a great increase of chalcidoid taxonomists and today there are at least 10 North American specialists working on various chalcidoid families, though not all spend their full time doing taxonomy. Several chalcidologists in Europe also fill important taxonomic gaps.

Most of these researchers, both student and professional, contributed to the keys of this manual. Unfortunately, at least three of the contributors have had to seek employment in fields unrelated to taxonomy even though chalcidoids are still so poorly known.

The relatively rapidly changing field of Nearctic chalcidoid taxonomy is shown by a comparison of the numbers of genera and species listed in the two most recent catalogs of the superfamily for North America. Peck (1963) recorded 2116 described species in 464 genera, Krombein et al. (1979) recorded 2223 described species in 489 genera, and the contributors to this work have noted about 2800 described and undescribed species in 706 genera (Table II). Though the numbers are not strictly comparable because of slightly different geographical coverage (e.g., Peck included Greenland but not Mexico, Krombein et al. excluded both, and our keys often include Nearctic parts of Mexico), a considerable increase in the number of genera and species recognized for the Nearctic region is evident. This increase is mainly due to the increased number of specialists of Chalcidoidea studying the Nearctic fauna. Yet, the species of this large region are still poorly known. For example, the United Kingdom has about 1,700 chalcid species and Europe, including the old European USSR west of the Ural mountains, has about 5,000 species (J. Noyes, personal communication). By comparison, America north of Mexico has only about 2,500 described species for a land mass that is 148 times the size of the UK and 1.8 times the size of Europe. These chalcid faunas are relatively small compared to those of the tropics. For example, although Costa Rica is 348 times smaller than North America, it has an estimated fauna of 4,400 chalcid species (Hanson and Gauld 1995).

There seems to be no trend in description of genus-group names by decade. Only four genera (*Chalcis*, *Eulophus*, *Leucospis*, and *Pteromalus*) were described before 1800. An increase of about 38% occurred in the 1900's relative to the 1800's. A summary of publication dates of genera and subgenera occurring in the Nearctic region is given in Fig. 1.

Chalcidoid collections

Major chalcidoid collections are in the USNM and CNC. Many universities and federal, provincial, and state organizations also have large and important holdings of Chalcidoidea, often built up over many decades. However, the material is often poorly preserved or badly prepared (if it is prepared at all), and even in the larger collections there is often a considerable backlog of prepared material needing identification at least to family or genus. Such material is therefore not immediately useful, or sometimes not even useable, for taxonomic studies. The accumulated specimens in collections probably will not be studied until they are sorted at least to family because few researchers are willing to borrow all holdings of a particular museum just to sort out a few specimens that may be of immediate interest for their current research. Geographical coverage of the continent is also relatively patchy, with large areas being under explored for chalcidoids. Consequently, our knowledge of distributions, even of genera, is very inadequate, as will become evident to users of the keys. It likely will require several more generations of research by numerous specialists to obtain the knowledge of North American chalcidoid species that is already known for such groups as the bees or ants and to have all the previously accumulated material properly curated and identified to species. Meanwhile, large amounts of freshly collected (though mostly unmounted) material from many areas, including endangered tropical and temperate ones, pour into museums. Scientists working on various biodiversity projects in such habitats rapidly require information on species diversity if their projects are to have impact in slowing the destruction of those areas. Hence the backlog of identifications and the need for taxonomists continue to increase just to keep pace with the ever growing collections. If more taxonomic expertise does not become available the 'biodiversity crisis' will be extended to the chalcidoid collections of North America, with material deteriorating to the point of uselessness before it can be properly prepared and studied.

Use of keys

Chalcidoidea are often difficult to key out because of their relatively small size (usually less than 3 mm), often high intraspecific variability, and the difficulty of seeing features on specimens that are usually less than perfectly preserved (shrivelled, dirty, or broken). Even using the best stereoscopic microscopes and optimal lighting some features are difficult to see in very small chalcidoids, which therefore should be slide mounted and examined with a compound microscope to confirm generic placement. Despite the difficulties, one should nevertheless be able to key correctly to genus the majority of chalcidoids encountered in the Nearctic region. For some groups an authoritatively identified reference collection is required for comparison to be certain that a genus is correctly identified. We encourage the users of the keys to persevere in keying out specimens. With patience and practice one should be able to key correctly to genus most chalcidoids collected, provided they are in good condition and well prepared.

Several of the contributors discuss use of keys at the end of their introductory sections. It is important to bear their comments in mind when keying specimens. Some general comments are appropriate here. Information given within one alternative of a couplet is in brackets if it is not contrasted in the opposite alternative. The annotations give specific distribution records for many genera but should not be interpreted as reliably representing the complete Nearctic distribution of a genus. Although distributional information may appear to help exclude certain groups, such information cannot be used reliably to help key a specimen to family or genus. For example, Agaonidae do not occur in Canada but occasionally are reported on *Ficus* in shopping malls there. The term 'widespread' refers to the genus as a whole, not to individual species unless, of course, only one species is known. The host range of most species is incompletely known and for many genera no host at all has yet been reliably reported. Rearing of potential hosts by professional and amateur biologists alike undoubtedly will yield many more and interesting host associations that should be reported to chalcidoid taxonomists. It is essential that host remains (and host species if known) as well as the chalcidoids are kept as vouchers to document the information.

We emphasize that this manual should be used only for Nearctic specimens because the diagnostic features provided may not apply to extralimital species. Despite this warning, it is probable that our keys will be used to identify material collected from other regions. Because of the way the keys are constructed one may well arrive at a genus name, but this may be incorrect. Let the user beware!

Table I.
List of geographic abbreviations used for distributions in annotations.

Canada

AB	Alberta
BC	British Columbia
LB	Labrador
MB	Manitoba
NB	New Brunswick
NF	Newfoundland
NS	Nova Scotia
NT	Northwest Territories
ON	Ontario
PE	Prince Edward Island
PQ	Quebec
SK	Saskatchewan
YT	Yukon Territory

United States

AK	Alaska
AL	Alabama
AR	Arkansas
AZ	Arizona
CA	California
CO	Colorado
CT	Connecticut
DC	District of Columbia
DE	Delaware
FL	Florida
GA	Georgia
IA	Iowa
ID	Idaho
IL	Illinois
IN	Indiana
KS	Kansas
KY	Kentucky
LA	Louisiana
MA	Massachusetts
MD	Maryland
ME	Maine
MI	Michigan
MN	Minnesota
MO	Missouri
MS	Mississippi
MT	Montana
NC	North Carolina
ND	North Dakota
NE	Nebraska
NH	New Hampshire
NJ	New Jersey
NM	New Mexico
NV	Nevada
NY	New York
OH	Ohio
OK	Oklahoma
OR	Oregon
PA	Pennsylvania
RI	Rhode Island
SC	South Carolina
SD	South Dakota
TN	Tennessee
TX	Texas
UT	Utah
VA	Virginia
VT	Vermont
WA	Washington
WI	Wisconsin
WV	West Virginia
WY	Wyoming

Other

GD	Greenland
SM	St. Pierre and Miquelon

Table II. Comparison of Chalcidoidea in Peck (1963), Krombein et al. (1979), and Gibson et al. (1997).

Classification used by Peck (1963)	Peck (literature up to ca. 1960)		Classification used by Krombein et al. (1979)	Krombein et al. (literature to ca. 1970)		Classification used here	Gibson et al. (literature through 1995)	
	genera	species + subspecies		genera	species + subspecies		genera	spp.***
Agaonidae	2	2	Agaoninae and Idaminae (Torymidae)	4	6	Agaonidae	15	19
Aphelinidae	19	120	Aphelininae (Encyrtidae)	20	133	Aphelinidae	15	140
Chalcidectidae	2	4	now in Pteromalidae	-	-	now in Pteromalidae	-	-
Chalcididae	12	97	Chalcididae	12	102	Chalcididae	17	150
Elasmidae	1	17	Elasminae (Eulophidae)	1	16	Elasmidae	1	29
Encyrtidae	*122	351	Encyrtidae (excluding Aphelininae and Signiphorinae)	137	367	Encyrtidae	173	524
Eucharitidae	6	28	Eucharitidae	6	28	Eucharitidae	7	32
Eulophidae	79	446	Eulophidae (excluding Elasminae)	82	498	Eulophidae	110	595
Eupelmidae	11	91	Eupelmidae (excluding Tanaostigmatinae)	12	91	Eupelmidae	21	110
Eurytomidae	19	235	Eurytomidae	22	261	Eurytomidae	23	250
Eutrichosomatidae	1	2	now in Pteromalidae			now in Pteromalidae		
Leucospidae	1	6	Leucospidae	1	6	Leucospidae	1	5
Mymaridae	*20	114	Mymaridae	21	120	Mymaridae	28	130
Ormyridae	2	16	Ormyrinae (Pteromalidae)	2	13	Ormyridae	1	16
Perilampidae	3	31	Perilampinae (Pteromalidae)	3	31	Perilampidae	6	40
Pteromalidae (excluding Eutrichosomatinae)	*119	309	Pteromalidae (excluding Ormyrinae and Perilampinae)	122	352	Pteromalidae	224	400
Signiphoridae	2	20	Signiphorinae (Encyrtidae)	3	22	Signiphoridae	3	20
Tanaostigmatidae	1	4	Tanaostigmatinae (Eupelmidae)	1	4	Tanaostigmatidae	2	16
Tetracampidae	1	1	not recorded	-	-	Tetracampidae	3	6
Torymidae	25	182	Torymidae (excluding Agaoninae)	23	174	Torymidae	21	200
Trichogrammatidae	19	39	Trichogrammatidae	17	43	Trichogrammatidae	35	75
TOTALS	**467**	****2144**		**489**	**2267**		**706**	**2757**

* Number includes one unplaced genus. **Number includes 29 unplaced species. ***Figures approximate because some authors included estimates of undescribed species.

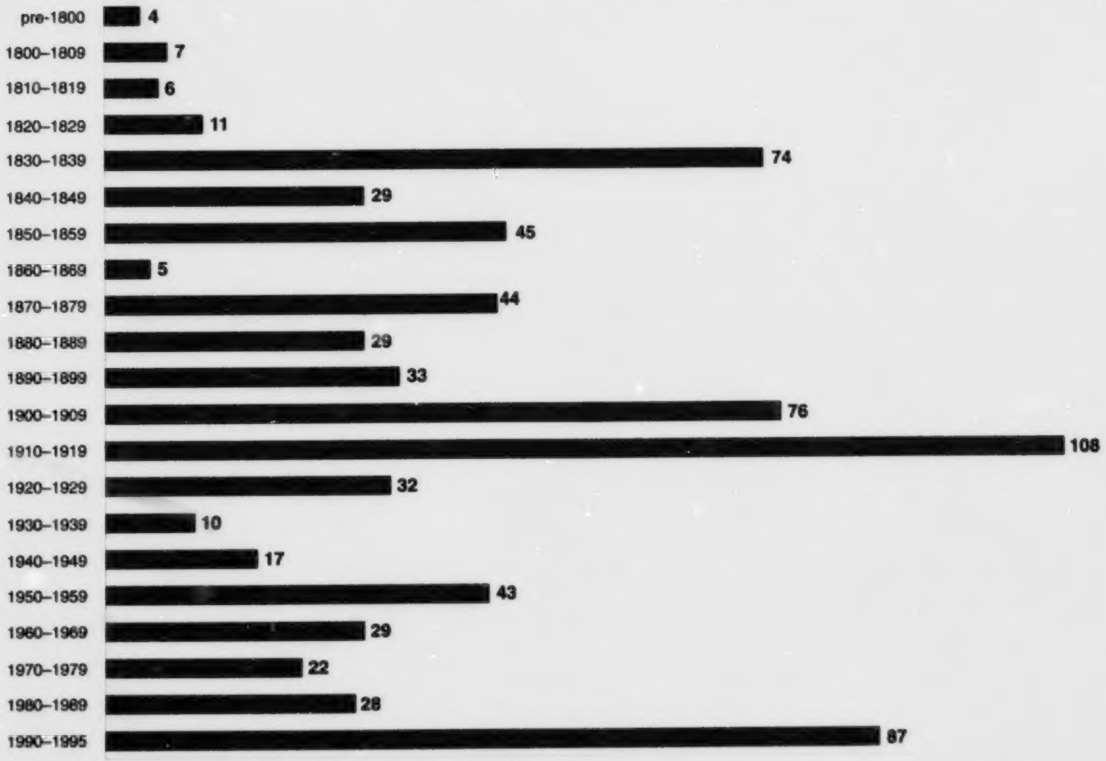

Fig. 1. Number of genera of Nearctic Chalcidoidea described by decade.

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Chapter 2. MORPHOLOGY AND TERMINOLOGY

Gary A. P. Gibson

Introduction. Morphology is the branch of biology that studies the form and structure of organisms. Terms given to structure are the language of morphology. Morphological terms are a form of shorthand to facilitate communication because they embody extensive implicit information, such as the type, location, function, and homology of structural features.

Inclusion of the word biology in the definition of morphology might be considered superfluous, but it is important to remember that all biological science is unified by the theory of evolution. Structural diversity must be interpreted within an evolutionary context if morphology is not only to differentiate structure but to explain and relate diversity, which is the ultimate aim of biology. Consequently, structural terms must embody evolutionary information, i.e., the concepts of evolutionary continuity and homology. However, the Chalcidoidea is a large and diverse group of organisms for which definitive knowledge of evolutionary history and relationships is largely lacking. Chalcidoid morphology and related terminology has developed over a long period of time from the work of a large number of individuals that often specialized on different groups. Further, most specialized terms have originated from taxonomic studies that are descriptive rather than comparative in nature. Because taxonomists are generally concerned with taxon recognition they tend to prefer and to create terms that are descriptive and easy to use for their own particular group, regardless of evolutionary or morphogenetic implications. As a result, chalcidology is saddled with a plethora of specialized structural terms (jargon), including different terms applied to the same structures in different groups and, rarely, even the same term applied to different (non-homologous) structures. Occasionally the use of some term is obviously inappropriate because of incorrect homology, but unlike zoological nomenclature there are no rules of morphological nomenclature to resolve the ambiguity of conflicting terms. Often different authors use different terms based on personal preference and no single set of terms is any more correct than any other.

It is neither the purpose nor the goal of this manual to standardize the use of morphological terms throughout the superfamily. Consequently, in a few instances different terms are used for what likely are homologous features in members of different families. While not acknowledging that the set of terms used here is in any way most appropriate or correct, contributors have endeavoured to use a single set of terms to facilitate use of the keys by others. Exceptions in common usage are because some specialized terms appear so widely and commonly in the literature of some families that a change for consistency in this manual could increase rather than decrease confusion of users. Users should also be aware that the terms 'sulcus', 'suture', 'line', and 'groove' often are used interchangeably.

The following description of structure includes only terms that are used in the keys or chapter introductions of this manual. Bouček (1988) should be consulted for a more comprehensive review of chalcidoid structure as well as for terms commonly employed for sculpture and setation. Some of the terms used are employed throughout entomology, whereas many have a restricted or specialized meaning in the Chalcidoidea. The latter terms are printed in bold italics where they are first used or defined, and more widely used or general terms are printed in bold face. Synonymous terms that are often used in the chalcidological literature are included in brackets after the relevant term. The definition of terms below sometimes differs from that given in the Torre-Bueno glossary of entomology compiled by Nichols (1989) because of a specialized meaning in the Chalcidoidea.

For quick reference, an alphabetical listing of illustrated terms, the abbreviation used for each term, and figure reference numbers are given in appendix I. An alphabetical listing of the abbreviations used to denote structures in illustrations throughout the manual is given in appendix II. Abbreviations that are unique to a particular chapter are given in the respective figure caption for that chapter.

CHALCIDOID STRUCTURE

In the keys, 'body' refers to the composite **head**, **thorax**, and **abdomen**, but excludes the appendages (legs, wings, antennae). Like other apocritan Hymenoptera, chalcidoids have the first abdominal segment rigidly attached to the thorax and there is a more or less flexible articulation between the first and second abdominal segments. Consequently, the middle section of the body is composed of the thorax plus first abdominal segment and the posterior section is composed of the abdomen minus the first abdominal segment. The middle section is called the **mesosoma** and the posterior section is called the **metasoma**. Structure is described below under these three body regions.

HEAD

The head usually is oriented more or less vertically, with the mouthparts either directed ventrally (**orthognathous**) or somewhat posteriorly in line with the direction of the procoxae (**hypognathous**); more rarely the head is almost horizontal, with the mouthparts directed anteriorly (**prognathous**). Almost all chalcidoids have a lateral pair of compound **eyes** (Fig. 1) composed of a large number of **facets** [= ommatidia] (Fig. 1: fct), and an **anterior** [= median] **ocellus** (Figs. 1, 8, 10: ao) and two **posterior** [= lateral] **ocelli** (Figs. 1, 10: po) typically arranged in a triangle dorsomedially between the eyes. Each eye has an **inner**, **outer**, **upper**, and **lower margin** [= orbit].

For descriptive purposes, the head is subdivided into several regions; boundaries between the regions are mostly indefinite so that the following definitions are necessarily often imprecise. In anterior view the head is composed of the **face** and **clypeus**. The **clypeus** (Figs. 1, 8, 9: cly) is a median region above the mouth; often it is distinguished from the rest of the face by a different sculpture, but its exact boundaries sometimes are indicated by an **anterior tentorial pit** (Fig. 1: atp) at each dorsolateral angle, by a transverse suture between the pits, and by a more or less vertical suture between each pit and the margin of the **mouth** [= oral] **cavity**. The **face** is the rest of the anterior surface of the head between the inner margins of the eyes and the anterior ocellus; it is subdivided into a dorsal **upper face** [= frons] (Figs. 1, 8: upf) and ventral **lower face** (Figs. 1, 8: lof) by an imaginary line connecting the ventral margins of the antennal toruli. The median part of the lower face between the dorsal limit of the clypeus and the toruli is the ***supraclypeal area*** (Figs. 1, 8: sca). The upper face usually is divided into several regions. In most chalcidoids there is a ***scrobe*** (depression) (Figs. 1, 8: scr) above each torulus and the two scrobes usually converge and unite into a single ***scrobal depression*** [= channel, cavity] (Figs. 1, 8, 9: scd). The region between the scrobes is the ***interantennal area*** (Figs. 1, 8: iaa), which is sometimes called the ***interantennal prominence/crest*** because it is convex, ridged, or even lobed. The ***parascrobal area*** (Figs. 1, 8, 9: psa) is the region between each scrobe and eye, and the 'breadth' of the upper face is the minimal distance between the eyes in frontal view. Sometimes the upper face has a ***preorbital carina*** (Figs. 1, 12: prc) parallelling the inner margin of the eye or varied patterns of grooves or lines of weaker sclerotization, usually in more or less X-, Y-, T- or H-like patterns. In Eulophidae, usually more or less ∨ -shaped grooves above the interantennal region are called ***frontofacial sutures*** [= scrobal sulcus] (Fig. 10: ffs), whereas a transverse groove below the anterior ocellus is the ***frontal suture*** (Fig. 10: fs), and a transverse groove on the vertex that extends from the eye anterior or posterior of the posterior ocellus is the ***vertexal suture*** [= occipital suture] (Fig. 10: vs). The frontal suture is sometimes angulate and is then called the ***frontal fork*** [= furca]. Mymarids have an unique H-like pattern of lines, the ***trabeculae*** (Fig. 11: trb), on the face and vertex; there is a transverse line on the upper face that connects with lines along the inner and upper margins of each eye. These lines are usually dark because they are thickened regions resulting from inrolled cuticle. On the lower face some chalcidoids also have ***subantennal grooves*** (Fig. 11: sag) or lines between each torulus and mouth margin.

The **vertex** (Figs 1, 13: vrt) is the top of the head behind the anterior ocellus and between the eyes, whereas the **temple** (Figs. 12, 13: tmp) is the top of the head behind each eye, and the **gena** (Figs. 1, 12, 13: gen) is the side of the head behind and below each eye. The combined vertex and upper face above the scrobes is sometimes referred to as the **frontovertex** (Fig. 8: fvr). The gena is usually differentiated from the lower face by a **malar** [= genal] **sulcus** (Figs. 1, 8, 12: msl), which extends between the lower margin of the eye and the mouth margin at the base of the mandible. The minimum distance between these two points is the **malar space** [= distance] (Fig. 1: msp). Sometimes there is a ***malar*** [= adoral] ***depression*** [= hollow] (Figs. 1, 9: mdp) above the base of each mandible and posteriorly the gena sometimes has a ***genal carina*** (Fig. 12: gc) extending from the ventrolateral corner of the mouth opening toward or behind the eye. A genal carina is not continuous dorsally and is thus distinguished from the **occipital carina** (Fig. 13: occ), a ∩ -shaped carina on the back of the head. Rarely the gena has a carina or sulcus extending posteriorly from the malar sulcus below the eye, which is called the ***postorbital carina*** (Figs. 1, 12: poc) when carinate and the ***postgenal sulcus*** (Fig. 1: pgs; chapter 10, Fig. 27) when groove-like and extending to the occipital foramen.

The posterior surface of the head has an opening, the **occipital foramen** [= foramen magnum] (Fig. 13: ocf), through which the head is connected to the mesosoma. The **occiput** (Fig. 13: oc) is the posterior surface of the head above the occipital foramen and the **postgenae** (Fig. 13: psg) are the posterolateral regions below the occipital foramen. Often the postgenae and occiput merge into the genae, temples, and vertex, but sometimes they are differentiated by an occipital carina or the occiput is abruptly, sometimes carinately, angled from the vertex and temples along an ***occipital margin***. The occipital foramen is either continuous with the mouth cavity or the two are separated by median inflections of the postgenae that form a **postgenal bridge** (Fig. 13: pgb). The mouth margin surrounding the labiomaxillary complex on the back of the head usually is carinate and is called the **hypostomal carina** (Fig. 13: hsc).

Mouthparts. The mouthparts are composed of the labrum, paired mandibles, and labiomaxillary complex. The **labrum** (Figs. 1, 12: lbr) is normally a flap-like sclerite visible below or partly to entirely concealed beneath the clypeus, but sometimes it is deeply emarginate so as to be 'digitate' (i.e., with finger-like projections). The **mandibles** (Figs. 1, 9: man) usually are well developed and toothed apically. Normally the mandibles curve inwards and meet or overlap medially when closed, but rarely they have broad, outwardly turned teeth that do not meet medially, in which case the mandibles are said to be 'exodont'. Though sometimes reduced, the **labiomaxillary complex** usually consists of a median **labium** (Fig. 13: lab) and a pair of **maxillae** (Fig. 13: max); normally each maxilla has a **maxillary palpus** (Fig. 13: mp) with up to 5 segments and the labium has a pair of **labial palpi** (Fig. 13: lp) with up to 3 segments.

Antenna. Each antenna is attached to the head through an opening in the head capsule, surrounded by a ring-like sclerite, the **torulus** (Figs. 1, 10: tor). The antenna consists of three segments, the **scape** (Figs. 2, 22: scp), **pedicel** (Figs. 2, 22: pdl), and **flagellum** (Fig. 2: flg). The ventral margin of the scape is often expanded into a carina or flange, the ***ventral plaque*** (Fig. 2: vpl), and the plaque or inner surface of the scape of males sometimes has a sensory region of pores. The scape is attached to the head by a basal constriction, the **radicle** (Figs. 2, 22: rad), which sometimes can be quite long.

The **flagellum** usually is divided into as many as 12 subsegments, the **flagellar segments** [= flagellomeres]. Three regions of the flagellum often are differentiated. One or more basal flagellar segments can be abruptly smaller (usually transverse or ring-like) and without longitudinal sensilla, and each of these segments is called an ***anellus*** (Figs. 2, 22: anl) or are termed 'anelliform'. Also, one or more terminal flagellar segments often are distinguished as a **clava** [= club] (Figs. 2, 22: clv) because the segment or segments are larger in size and/or 2–6 **claval segments** are partly or completely fused. When partially fused the segments are completely or incompletely separated by transverse or oblique sutures [= septa]. A ***terminal spine*** [= spicula] (Fig. 2: ts) sometimes projects from the apex of the clava and the clava often has a sensory region, the ***micropilose area*** (Fig. 2: mpa), apically or ventrally. The micropilose region often is collapsed in air-dried specimens. The ***funicle*** (Figs. 2, 22: fun) is that part of the flagellum between the anelli and clava and it is composed of a varied number of ***funicular segments*** (Fig. 2: fu). Normally the flagellum is 'filiform' because the segments are subequally wide, or 'clavate' [= clubbed] because the segments widen conspicuously toward the club, but sometimes one or more funicular segments have a dorsal projection [= lobe, ramus] and depending on the length and shape of the projection the flagellum can be termed 'lobed', 'serrate' or 'branched' [= ramose]. The number of segments comprising each of the five components of the antenna (i.e., scape, pedicel, anelli, funicle, clava) sometimes is expressed as the ***antennal formula***. For example, an antenna with a flagellum composed of 3 anelli, 5 funicular segments, and 3 claval segments would have an antennal formula of 11353.

Characteristic of chalcidoid antennae are ridge-like ***longitudinal sensilla*** [= multiporous plate sensilla, linear sensilla, placoid sensilla, rhinaria] (Figs. 2, 22, 23: ls) on some or all of the flagellar segments. The apices of longitudinal sensilla project free for varied lengths above the surface and/or beyond the apex of the respective flagellar segment. Sometimes the apically free portion of each sensillum is very long so that longitudinal sensilla appear hair-like (Fig. 23) rather than ridge-like (Fig. 22), in which case they may be mistaken for **setae** [= trichoid sensilla] (Figs. 2, 22, 23: set). However, the base of a longitudinal sensillum is continuous with the surface of the segment, whereas the base of a seta/trichoid sensillum is articulated (Fig. 23). The flagellum, particularly the clava, sometimes also has mushroom-shaped **capitate peg sensilla** [= sensilla ampullacea] (chapter 22, Figs. 3, 11: cps).

MESOSOMA

The mesosoma is composed of three thoracic segments (**prothorax**, **mesothorax**, and **metathorax**) and the first abdominal segment, the **propodeum** (Figs. 3, 4, 18–20: ppd). The three pairs of legs are designated as 'front', 'middle', and 'hind', but parts of the legs are distinguished by the prefix for the respective thoracic segment ('pro', 'meso', 'meta'). Wings are present only on the mesothorax and metathorax, the **forewing** and **hind wing** respectively.

Prothorax. The most conspicuous part of the prothorax is the **pronotum** (Figs. 3, 4, 14, 15, 17, 19: no$_1$), which usually is ∩ -like and more or less loosely articulated with the mesothorax. The pronotum often has a subhorizontal posterior surface, the ***collar*** (Figs. 3, 12, 18: clr), and an anteriorly convergent sloping surface, the ***neck*** [= collum] (Fig. 3: nck); the two regions are sometimes distinguished by a transverse **pronotal carina** (Figs. 3, 12: pca). The pronotal collar usually is 'entire' (i.e., evenly sclerotized), but sometimes is divided mediolongitudinally. The more or less vertical side of the pronotum below the mesothoracic spiracle is the ***lateral panel*** (Figs. 4, 12, 18: lpp), which covers a **propleuron** (Figs. 4, 17: pl$_1$) on either side of a median, typically diamond-shaped **prosternum** (Fig. 17: st$_1$).

Mesothorax. The mesothorax forms the largest part of the mesosoma. The **mesonotum** (Figs. 3, 4: no$_2$) is almost always divided into an anterior **mesoscutum** (Fig. 19: msc) and posterior **scutellar-axillar complex** by a transverse line of weakness, the **transscutal articulation** [= sulcus, suture] (Figs. 3, 14–16: tsa), at the level of the base of the forewings. A typically oval **tegula** (Figs. 3, 4, 14, 19: tgl) covers the region where the forewing is articulated with the mesothorax. The **mesoscutum** usually is differentiated into a

midlobe (Figs. 3, 4, 14, 15: mlm) and two **lateral lobes** [= scapulae] (Figs. 3, 4, 14, 15, 18: llm) by paramedial sulci, the **notauli** (Figs. 3, 4, 14, 15, 18: not). In dorsal view (Fig. 3) the notauli usually originate anteriorly near each mesothoracic spiracle (Fig. 18) and converge posteriorly; if they are 'complete' (i.e., extend to the transscutal articulation) they often end near the inner angles of the axillae. Anteriorly on each lateral lobe is sometimes a differentiated band of sculpture, the **parapsidal line** (Fig. 3: pl), and sometimes the midlobe has one or more rows of differentiated ***adnotaular setae*** (Fig. 3: ans) adjacent to the notauli. The scutellar-axillar complex is usually composed of an antero-lateral pair of **axillae** (Figs. 3, 4, 14–16, 18, 19: ax) and a median **scutellum** (Figs. 3, 4, 19, 20: sct) separated by the **scutoscutellar suture** (Figs. 3, 14: sss). The term axilla is used for the dorsal surface of the axilla; its lateral, vertical surface is called the ***lateral panel*** (Figs. 4, 19: lpa) of the axilla. When the transscutal articulation is deeply sinuate the axillae project forward of the base of the scutellum (Figs. 3, 15) and are said to be 'advanced'. In Eulophidae the axilla sometimes is so strongly advanced that it differentiates a slender region of the lateral lobe, the ***scapular flange*** (Figs. 3, 15: sf) between itself and the midlobe of the mesoscutum. The scutellum sometimes is also subdivided by longitudinal lines or grooves, either medially (Fig. 16) or by a pair of longitudinal sulci. Longitudinal lines or sulci close to the midline are called ***submedian grooves/lines*** (Figs. 3, 15: smg), whereas sulci on or very close to the sides of the scutellum are called ***sublateral grooves*** (Figs. 3, 15, 18: slg) in Eulophidae and ***axillular grooves*** (Figs. 3, 14: axg) in most other Chalcidoidea. The sublateral or axillular groove differentiates a usually more or less vertical, lateral region of the scutellum, the ***axillula*** (Figs. 3, 4, 14, 15, 18: axl), between itself and the usually posteriorly sloping axilla. Posteriorly the scutellum sometimes also has a subapical region, the ***frenum*** (Figs. 3, 4, 14: fre) [= frenal area], differentiated by a transverse carina, groove, row of foveae, or change of sculpture, the ***frenal line/groove*** (Figs. 3, 14: frl). Many Mymaridae have the scutellum similarly, but much more conspicuously, differentiated into anterior and posterior portions, which are termed the ***anterior scutellum*** (Fig. 16: as) and ***posterior scutellum*** (Fig. 16: ps). Though often very distinctive it is possible that the posterior scutellum is homologous with the frenum of other chalcidoids. The extreme apex of the scutellum can also have a differentiated ***marginal rim*** (Figs. 3, 4: mrs) along its posterior margin.

In lateral view the mesothorax is usually composed of the **prepectus** (Figs. 4, 12, 17–19: pre) and **mesopleuron** (Fig. 4: pl_2). The prepectus is reduced and difficult to distinguish in some chalcidoids (Fig. 12), but typically it is subtriangular in shape (Figs. 4, 18, 19) and present either as two separate lateral sclerites or as a continuous semiannular sclerite under the procoxae.

Only rarely is the prepectus completely fused with the pronotum, in which case the pronotum is rigidly associated with the rest of the mesosoma. The **mesothoracic** [= prothoracic] **spiracle** (Figs. 4, 18, 19: spr) is along the anterolateral margin of the mesoscutum, typically at or near the juncture formed between the mesoscutal margin, the pronotum, and the anterodorsal angle of the prepectus; rarely the spiracle is surrounded by pronotal cuticle when the prepectus is fused with the pronotum. The mesopleuron usually has a small, often slightly convex region, the ***acropleuron*** [= subalar area] (Figs. 4, 18: acr), below the base of the forewing. Usually the mesopleuron is also obliquely subdivided by a **mesopleural suture** (Figs. 4, 18: pls) and/or by a concave ***femoral depression*** (Figs. 4, 17: fmd) that extends between the mesocoxa and acropleuron for reception of the mesofemur. The mesopleural suture subdivides the mesopleuron into an anteroventral **mesepisternum** (Fig. 4: es_2) and a posterior **mesepimeron**. Encyrtidae, Tanaostigmatidae, and some Aphelinidae and Eupelmidae have the acropleuron greatly enlarged, forming a longitudinal, convex region that extends to or almost to the metapleuron and meso- and metacoxae (Fig. 19: acr). In such instances the mesepimeron and mesepisternum are greatly reduced or absent (Fig. 19). When present, the mesepimeron is sometimes divided into an ***upper mesepimeron*** (Figs. 4, 18: uep_2) and ***lower mesepimeron*** (Figs. 4, 18: lep_2) by a ***transepimeral sulcus*** (Figs. 4, 18: tps). The transepimeral sulcus is quite varied, often arched posterodorsally from near the mesocoxa or extending diagonally or transversely from the mesopleural sulcus, or sometimes reduced to a single pit. The mesepisternum sometimes also has a lighter-colored line or line of differentiated sculpture, the ***transepisternal line***, or a more distinct groove, the ***transepisternal sulcus*** [= precoxal suture] (Figs. 4, 18: tss) extending from the anterolateral corner of the mesocoxa toward the procoxa; this line/sulcus differentiates an ***upper mesepisternum*** (Figs. 4, 18: ues_2) between itself and the mesopleural suture, and a ***lower mesepisternum*** (Figs. 4, 18: les_2) below it, the lower mesepisternum comprising most of the **mesothoracic venter** [= mesosternum]. The bases of the mesocoxae usually abut against and conceal a dorsally reflexed part of the mesothoracic venter, the ***mesotrochantinal plate*** (Fig. 17: mtp), through which the mesocoxal foramina open into the mesothorax. Anteriorly the mesepisternum sometimes is carinately margined ventrally and/or laterally behind the procoxa, and in Eulophidae this carina is called the **epicnemial carina** (chapter 10, Fig. 240: epc).

Metathorax. The metathorax is much smaller and simpler than the mesothorax. The **metanotum** (Figs. 3, 4, 18, 19: no_3) often is differentiated into a median ***dorsellum*** (Figs. 3, 15, 20: dor) and two ***lateral panels*** (Figs. 3, 15, 20: lpm), but the **metapleuron** (Figs. 4, 18, 19: pl_3) usually is triangular or rectangular and is not subdivided. The **metasternum** (Fig. 17: st_3) is mostly concealed under the bases of the metacoxae, but sometimes it is carinate and the pattern of the carinae can be taxonomically important; usually at least one metacoxa has to be removed to observe the pattern.

Propodeum. The propodeum has been used extensively for taxonomic characters because there is a great diversity of sculpture, such as presence and placement of carinae. The diversity of structure is reflected in the amount of jargon within the Chalcidoidea. The propodeum is connected with the metasoma through the **propodeal foramen** (Figs. 3, 17: ppf), which can be very broad to narrow (see under metasoma); when narrow the posteromedian portion of the propodeum can be slightly to conspicuously prolonged into a neck-like ***nucha*** (Figs. 3, 20: nuc). The **propodeal spiracles** (Figs. 3, 20: spr) are sublateral, usually near the anterior margin of the propodeum. Often there is a longitudinal, diagonal, or arcuate depression or furrow behind the spiracle, called the ***paraspiracular sulcus*** (Fig. 3: pss) in Eulophidae and the ***postspiracular sulcus*** (Figs. 3, 20: pss) in some other families. In Eulophidae a carinate inner margin of the sulcus is called the ***paraspiracular carina*** (Fig. 3: psc). The propodeum lateral to each spiracle or spiracular sulcus is the ***callus*** (Figs. 3, 4, 14, 18: cal); the callus is often convex and at least partly setose, and posteriorly is sometimes reflexed over the metacoxa as the ***supracoxal flange*** (Figs. 3, 4, 20: scf). Medially the propodeum is often subdivided by a series of carinae, including a longitudinal ***median carina*** (Figs. 3, 20: mc), a sublateral ***plical carina*** (***plicae***) (Figs. 3, 20: plc) mesal to each spiracular sulcus, and a transverse carina, the ***costula*** (Figs. 3, 20: cos), near its middle. A carina or furrow can also delimit a transverse ***adpetiolar strip/triangle*** (Fig. 3: aps) anterior to the propodeal foramen. Because of the great diversity of features, other propodeal regions and structural and sculptural features are defined under 'Use of keys' for the relevant families.

Wings. Most taxonomic characters of the wings involve only the forewings. A basally thickened part of the forewing, the **humeral plate** (Fig. 5: hpl), articulates with the mesonotum and mesopleuron through a series of **axillary sclerites**. The humeral plate is distinguished from the rest of the forewing by a constriction, which delimits the base of the **submarginal vein** (Fig. 5: smv) and **costal cell** (Fig. 5: cc). The costal cell is the membranous region anterior to the submarginal vein and lengths of both the costal vein and cell are measured from the basal constriction to the point at which the submarginal vein touches the anterior margin of the wing (Fig. 5). The height of the costal cell is the maximum distance between the subcostal vein and the anterior margin of the wing membrane. The apex of the submarginal vein is sometimes differentiated because it is abruptly curved, thickened, and/or separated slightly the marginal vein, and this region is called the ***parastigma*** [= premarginal vein] (Fig. 5: pst). The submarginal vein is said to be 'broken' if the base of the parastigma narrows and is separated slightly from the rest of the submarginal vein; rarely the parastigma projects posteriorly onto the wing membrane. In addition to the submarginal vein, the wing venation typically consists of a **marginal vein** (Fig. 5: mv), **stigmal vein** (Fig. 5: stv), and **postmarginal vein** (Fig. 5: pmv), though one or more of these veins can be reduced or missing. Origin of the stigmal vein demarcates the marginal vein from the postmarginal vein (Fig. 5). Usually the apex of the stigmal vein is enlarged into a more or less knob-like ***stigma*** (Fig. 5: stg), from which often a stub-like vein, the ***uncus*** (Fig. 5: unc), is directed toward the postmarginal vein. Usually there are a few circular sensilla near the apex of the stigmal vein or within the uncus, and the relative position of these sensilla is sometimes taxonomically important. Length of the stigmal vein is maximum length measured from the angle formed between itself and the postmarginal vein, whereas length of the marginal vein is from the submarginal vein to the angle formed between the stigmal vein and postmarginal vein, and length of the postmarginal vein is maximal length from the angle formed between itself and the stigmal vein (Fig. 5). The location of specific setae on the veins is taxonomically important in the Mymaridae and Signiphoridae and 'Use of key' should be consulted in these chapters for relevant setal nomenclature. The wing often also has one or more folds in the membrane and/or differentiated lines of setae. Folds/setal lines that are common to many chalcidoids include the ***basal fold/setal line*** (Fig. 5: bsl), which is directed posterobasally from the parastigma, the ***cubital fold/setal line*** (Fig. 5: csl), which is directed longitudinally from near the base of the submarginal vein to or partly to the apical margin of the wing, and the ***subcubital fold/setal line*** (Fig. 5: scl), which is adjacent to the posterior margin of the wing. The ***basal cell*** (Fig. 5: bc) is the region enclosed by the submarginal vein, basal fold/setal line, and cubital fold/setal line (if present). The wing **disc** (Fig. 5) is the membranous region behind and beyond the base of the marginal vein. The disc is rarely bare, but more commonly it is setose or setose except often for a bare region, the ***speculum*** (Fig. 5: spc), immediately beyond the basal fold/setal line behind the parastigma. The wing disc can also have a narrow, oblique bare band, the ***linea calva*** (chapter 8, Fig. 41: lc), directed from the posterobasal margin of the wing toward the base of the stigmal vein. In Encyrtidae and Aphelinidae the linea calva is 'entire' if it is devoid of any setae in the bare area; it is 'open' if the bare band is continuous to the posterior margin of the wing, but 'closed' if posteriorly the linea calva is enclosed by a dorsal line or lines of setae, and 'interrupted' if there are one or more dorsal setae at some intermediate point within the bare band. The linea calva also sometimes has a dorsal row of differentiated, thickened setae, the ***filum spinosum*** (chapter 8, Fig. 41: fsp), along its apical margin. The wing disc sometimes also has distinct setal lines [= tracks] (Fig. 5: sl), which in Trichogrammatidae have a specialized nomenclature that is explained in 'Use of key' for that chapter. There sometimes also is a differentiated line of ***admarginal setae*** (Fig. 5: ams) on the ventral surface of the wing behind the marginal vein and variedly long **marginal setae** (Fig. 5: ms) usually project from around the wing margin.The **retinaculum** is the ventrally curved posterior margin of the forewing, onto which hook-like **hamuli** of the hind wing attach to connect the wings during flight.

Legs. Each leg is composed of six segments, a **coxa** (Figs. 4, 18: cx), **trochanter**, **femur**, **tibia** (Fig. 24: tb), **tarsus**, and **pretarsus**. Each **tarsus** is almost always subdivided into 3–5 **tarsal segments**; the basal segment is the **basitarsus** (Fig. 24: bst). The apical pretarsus bears a pair of **tarsal claws** and care should be taken not to include the pretarsus when counting the number of tarsal segments. The protibia and mesotibia each have a single **tibial spur** (Fig. 24: tbs), whereas the metatibia has one or two spurs. Most often the **protibial spur** is short and straight (inconspicuous and needle-like) when there are 3 or 4 tarsal segments, but relatively robust, curved, and apically cleft [= bifid, bifurcate] (Fig. 24) when there are 5 tarsal segments. The protibial spur and basitarsus function together as an antennal cleaning organ. The spur is called the **calcar** (Fig. 24: clc), and a straight calcar is correlated with a basitarsus with a straight ventral margin, whereas a curved calcar often is correlated with a basitarsus with an emarginate ventral margin. In both cases the basitarsus has a row of modified setae, the **strigil** (Fig. 24: str). The antenna is drawn between the calcar and strigil to be cleaned. Those chalcidoids with an enlarged acropleuron also often have a row or patch of **mesotibial apical pegs** (chapter 11, Figs. 143–145: map) on the anterior apical margin of the mesotibia, and various patterns of **mesotarsal pegs** on the ventral surface of the mesotarsal segments.

METASOMA

The metasoma consists of the ***petiole*** (Figs. 6, 20: ptl), which is the first metasomal tergum (Fig. 6: Mt_1) [= second abdominal tergum], plus 7 or 8 postpetiolar segments that together comprise the ***gaster*** (Fig. 6). Some chalcidoids have a transversely strip-like petiole, in which case the mesosoma and metasoma are broadly attached and the metasoma is said to be 'sessile'. In such instances the petiole may not be visible. Alternatively, the petiole can be in the form of a tube of varied length, in which case there is a distinct constriction between the mesosoma and metasoma and the gaster or metasoma is said to be 'petiolate'. Chalcidoids with a tube-like petiole sometimes have it supported ventrally by a flange-like extension (Figs. 6, 20: ptf) of the first gastral sternum (Fig. 6: Gs_1). There is only one pair of functional **spiracles** (Figs. 6, 21: spr), on the seventh metasomal (Mt_7) or sixth gastral (Gt_6) tergum (Figs. 6, 21). Most chalcidoids also have a pair of sensory **cerci**, usually on Mt_8 (= Gt_7) (Figs. 6, 21: cer). The cerci either are setose, finger-like projections that articulate with the tergum (then sometimes described as 'exserted') or are low tubercle or plate-like structures on the tergum that bear several conspicuous setae. In some instances Mt_8 is divided transversely by a groove anterior to and below each cercus; this groove probably represents a suture marking the line of fusion between Mt_8 and Mt_9, and for this reason Mt_8 is sometimes called the **syntergum** [= epipygium of some authors] (Figs. 6, 21: syn). In relatively few chalcidoids Mt_8 and Mt_9 (Gt_7 and Gt_8) are separate, in which case the cerci are on Mt_9 (Fig. 6). Rarely, there is also a more or less separated and sclerotized, partly setose, often flap-like sclerite posterior to Mt_8, which is sometimes called the ***epipygium*** (chapter 21, Figs. 14 and 15: epi). At present it is uncertain whether the epipygium represents a true Mt_9 in some or all instances, or has evolved through secondary division of Mt_8 or from some other structure. A similar (but non-homologous) flap-like sclerite, known as the ***anal sclerite***, covers the anus in some female eupelmids (chapter 11, Fig. 77: asc). Because the metasomal spiracles are only rarely absent and always on Mt_7 (Gt_6) when present, they are useful landmarks for determining the number of terga by counting anteriorly and posteriorly.

Normally the syntergum or Mt_8 of females extends ventrally and anteriorly on either side of the ovipositor sheaths below or under the other terga (Fig. 6). This ventrolateral region of the syntergum is called the ***outer plate*** (Fig. 6: opo) of the ovipositor; anteriorly each outer plate is articulated with the base of the ovipositor. In most Encyrtidae the cerci are displaced conspicuously anterior of their normal location near the end of the metasoma, in which case the median and lateral parts of the terga are more or less extended between and on either side of the cerci (Fig. 21) in an M-like manner. In such females the syntergum is composed of a median dorsal plate, which is often large and subtriangular, and each outer plate of the ovipositor is separated as a distinct sclerite that is connected to the rest of the syntergum by membrane. Some of these females also have a linear sclerite, the ***paratergite***, in the membranous line on either side of the syntergum posterior to each cercus.

Ventrally, males have seven visible sterna (Gs_1–Gs_7) whereas females normally have five visible sterna (Gs_1–Gs_5). The apical sternum is called the **hypopygium** (Figs. 6, 21: hyp); usually this is the largest sternum and sometimes it projects posteriorly into a spine-like ***mucro*** (Figs. 6, 21: muc). Unlike males, the sterna of females may be restricted to the basal part of the metasoma and in such cases the **ovipositor** (Fig. 6: ovp) is visible from below. The ovipositor consists of the protective outer **ovipositor sheaths** [= gonostyli, third valvulae] (Figs. 6, 21: osh) on either side of the median **stylets** [= first and second valvulae] (Fig. 6: ost), which do the actual drilling. The ovipositor is said to be 'exserted' if it projects beyond the apex of the metasoma. The genitalia of males consists of the **genital capsule** (Fig. 7), usually composed of a more or less tubular **phallobase** (Figs. 7, 25: phl) surrounding the **aedeagus** (Figs. 7, 25: adg); posteriorly the phallobase is differentiated into lateral **parameres** (Figs. 7, 25: par) and median **volsellae** (Figs. 7, 25: vls). Each volsella normally also has its apex differentiated as the **digitus** (Figs. 7, 25: dig), which has one or more curved **digital spines** (Figs. 7, 25: dgs). The typically lanceolate aedeagus usually has lateral **aedeagal apodemes** (Fig. 7: aap) projecting anteriorly for muscle attachment.

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Appendix I

Alphabetical listing of terms illustrated in morphology chapter figures

Term/structure	Abbreviation: figure
acropleuron	acr: 4, 18, 19
admarginal setae	ams: 5
adnotaular setae	ans: 3
adpetiolar strip	aps: 3
aedeagal apodeme	aap: 7
aedeagus	adg: 7, 25
anellus	an: 2, 22
anterior ocellus	ao: 1, 8, 10
anterior scutellum	as: 16
anterior tentorial pit	atp: 1
axilla	ax: 3, 4, 14–16, 18, 19
axillula	axl: 3, 4, 14, 15, 18
axillular groove	axg: 3, 14
basal cell	bc: 5
basal setal line	bsl: 5
basitarsus	bst: 24
calcar	clc: 24
callus	cal: 3, 4, 14, 18
cercus	cer: 6, 21
clava	clv: 2, 22
clypeus	cly: 1, 8, 9
collar of pronotum	clr: 3, 12, 18
costal cell	cc: 5
costula	cos: 3, 20
coxa (pro, meso, meta)	$cx_{1\text{-}3}$: 4, 18, 20
cubital setal line	csl: 5
digital spine	dgs: 7, 25
digitus	dig: 7, 25
dorsellum	dor: 3, 15, 20
facet of eye	fct: 1
femoral depression	fmd: 4, 17
flagellum	flg: 2
frenal line	frl: 3, 14
frenum	fre: 3, 4, 14

Term/structure	**Abbreviation: figure**
frontal suture	fs: 10
frontofacial suture	ffs: 10
frontovertex	fvr: 8
funicle	fun: 2, 22
funicle segment	fu$_n$: 2
gastral sternum	Gs$_n$: 6
gastral tergum	Gt$_n$: 6, 21
gena	gen: 1, 12, 13
genal carina	gc: 12
humeral plate	hpl: 5
hypopygium	hyp: 6, 21
hypostomal carina	hsc: 13
interantennal area	iaa: 1, 8
labial palpus	lp: 13
labium	lab: 13
labrum	lbr: 1, 12
lateral lobe of mesoscutum	llm: 3, 4, 14, 15, 18
lateral panel of axilla	lpa: 4, 19
lateral panel of metanotum	lpm: 3, 15, 20
lateral panel of pronotum	lpp: 4, 12, 18
longitudinal sensilla	ls: 2, 22, 23
lower face	lof: 1, 8
lower mesepimeron	lep$_2$: 4, 18
lower mesepisternum	les$_2$: 4, 18
malar depression	mdp: 1, 9
malar space	msp: 1
malar sulcus	msl: 1, 10, 12
mandible	man: 1, 9
marginal rim of scutellum	mrs: 3, 4
marginal setae	ms: 5
marginal vein	mv: 5
maxilla	max: 13
maxillary palpus	mp: 13
median carina	mc: 3, 20
mesepisternum	es$_2$: 4
mesonotum	no$_2$: 3, 4
mesopleural suture	pls: 4, 18
mesopleuron	pl$_2$: 4

Term/structure	**Abbreviation: figure**
mesoscutum	msc: 19
mesotrochantinal plate	mtp: 17
metanotum	no$_3$: 3, 4, 18, 19
metapleuron	pl$_3$: 4, 18, 19
metasomal tergum	Mt$_n$: 6, 21
metasternum	st$_3$: 17
micropilose area	mpa: 2
midlobe of mesoscutum	mlm: 3, 4, 14, 15
mucro	muc: 6, 21
neck of pronotum	nck: 3
notaulus	not: 3, 4, 14, 15, 18
nucha	nuc: 3, 20
occipital carina	occ: 13
occipital foramen	ocf: 13
occiput	oc: 13
outer plate of ovipositor	opo: 6
ovipositor	ovp: 6
ovipositor sheath	osh: 6, 21
ovipositor stylet	ost: 6
paramere	par: 7, 25
parapsidal line	pl: 3
parascrobal area	psa: 1, 8, 9
paraspiracular carina	psc: 3
paraspiracular sulcus	pss: 3
parastigma	pst: 5
pedicel	pdl: 2, 22
petiolar flange	ptf: 6, 20
petiole (Mt$_1$)	ptl: 6, 20
phallobase	phl: 7, 25
plica	plc: 3, 20
posterior ocellus	po: 1, 10
posterior scutellum	ps: 16
postgena	psg: 13
postgenal bridge	pgb: 13
postgenal sulcus	pgs: 1
postmarginal vein	pmv: 5
postorbital carina	poc: 1, 12
postspiracular sulcus	pss: 3, 20

Term/structure	Abbreviation: figure
preorbital carina	prc: 1, 12
prepectus	pre: 4, 12, 17–19
pronotal carina	pca: 3, 12
pronotum	no_1: 3, 4, 14, 15, 17, 19
propleuron	pl_1: 4, 17
prosternum	st_1: 17
propodeal foramen	ppf: 3, 17
propodeum	ppd: 3, 4 18–20
radicle	rad: 2, 22
scape	scp: 2, 22
scapular flange	sf: 3, 15
scrobal depression	scd: 1, 8, 9
scrobe	scr: 1, 8
scutellum	sct: 3, 4, 19, 20
scutoscutellar suture	sss: 3, 14
seta	set: 2, 22, 23
speculum	spc: 5
spiracle	spr: 3, 4, 6, 18–21
stigma	stg: 5
stigmal vein	stv: 5
strigil	str: 24
subantennal groove	sag: 11
subcubital line	scl: 5
sublateral groove	slg: 3, 15, 18
submarginal vein	smv: 5
submedian groove	smg: 3, 15
supraclypeal area	sca: 1, 8
supracoxal flange	scf: 3, 4, 20
syntergum	syn: 6, 21
tegula	tgl: 3, 4, 14, 19
temple	tmp: 12, 13
terminal spine	ts: 2
tibia (pro, meso, meta)	tb_{1-3}: 24
tibial spur	tbs: 24
torulus	tor: 1, 10
trabecula	trb: 11
transepimeral sulcus	tps: 4, 18
transepisternal sulcus	tss: 4, 18

Term/structure	Abbreviation: figure
transscutal articulation	tsa: 3, 14–16
uncus	unc: 5
upper face	upf: 1, 8
upper mesepimeron	uep$_2$: 4, 18
upper mesepisternum	ues$_2$: 4, 18
ventral plaque	vpl: 2
vertex	vrt: 1, 13
vertexal suture	vs: 10
volsella	vls: 7, 25

Appendix II

Alphabetical listing of abbreviations used to designate structures in illustrations throughout manual

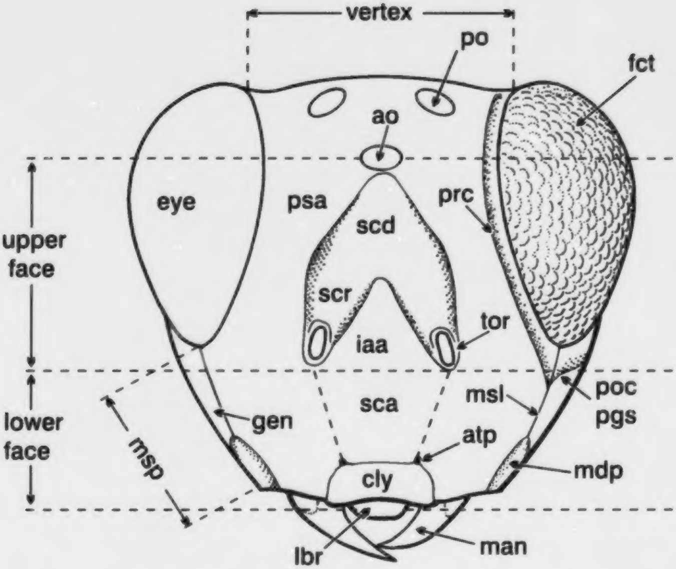
aap	aedeagal apodeme
acr	acropleuron
adg	aedeagus
ams	admarginal setae
an	anellus
ans	adnotaular setae
ao	anterior ocellus
aps	adpetiolar strip
as	anterior scutellum
asc	anal sclerite
atp	anterior tentorial pit
ax	axilla
axg	axillular groove
axl	axillula
bc	basal cell
bsl	basal setal line
bst	basitarsus
cal	callus
cc	costal cell
cer	cercus
clc	calcar
clr	collar of pronotum
clv	clava

cly	clypeus
cos	costula
cps	capitate peg sensilla
csl	cubital setal line
cx$_{1-3}$	coxa (pro, meso, meta)
dgs	digital spine
dig	digitus
dor	dorsellum
em$_2$	mesepimeron
epi	epipygium
es$_2$	mesepisternum
fct	facet
ffs	frontofacial suture
flg	flagellum
fl$_n$	flagellar segment
fmd	femoral depression
fre	frenum
frl	frenal line
fs	frontal suture
fsp	filum spinosum
fun	funicle
fu$_n$	funicle segment
fvr	frontovertex
Gs$_n$	gastral sternum
Gt$_n$	gastral tergum
gc	genal carina
gen	gena
hpl	humeral plate
hsc	hypostomal carina
hyp	hypopygium
iaa	interantennal area
lab	labium
lbr	labrum
lc	linea calva
lep$_2$	lower mesepimeron
les$_2$	lower mesepisternum
llm	lateral lobe of mesoscutum
lof	lower face
lp	labial palpus
lpa	lateral panel of axilla

lpm	lateral panel of metanotum
lpp	lateral panel of pronotum
ls	longitudinal sensilla
max	maxilla
mc	median carina
mdp	malar depression
man	mandible
mlm	midlobe of mesoscutum
mp	maxillary palpus
mpa	micropilose area
mrs	marginal rim of scutellum
ms	marginal setae
msc	mesoscutum
msl	malar sulcus
msp	malar space
Mt_n	metasomal tergum
mtp	mesotrochantinal plate
muc	mucro
mv	marginal vein
nck	neck of pronotum
no_{1-3}	notum (pro, meso, meta)
not	notaulus
nuc	nucha
oc	occiput
occ	occipital carina
ocf	occipital foramen
opo	outer plate of ovipositor
osh	ovipositor sheath
ost	ovipositor stylet
ovp	ovipositor
par	paramere
pca	pronotal carina
pdl	pedicel
pgb	postgenal bridge
pgs	postgenal sulcus
phl	phallobase
pl	parapsidal line
pl_{1-3}	pleuron (pro, meso, meta)
plc	plica
pls	pleural suture

pmv	postmarginal vein
po	posterior ocellus
poc	postorbital carina
ppd	propodeum
ppf	propodeal foramen
prc	preorbital carina
pre	prepectus
psa	parascrobal area
psc	paraspiracular carina
ps	posterior scutellum
psg	postgena
pss	paraspiracular or postspiracular sulcus
pst	parastigma
ptf	petiolar flange
ptl	petiole (Mt$_1$)
rad	radicle
sag	subantennal groove
sca	supraclypeal area
scd	scrobal depression
scf	supracoxal flange
scl	subcubital line
scp	scape
scr	scrobe
sct	scutellum
set	seta
sf	scapular flange
slg	sublateral groove
smg	submedian groove
smv	submarginal vein
spc	speculum
spr	spiracle
sss	scutoscutellar suture
st$_{1-3}$	sternum (pro, meta)
stg	stigma
str	strigil
stv	stigmal vein
syn	syntergum
tb$_{1-3}$	tibia (pro, meso, meta)
tbs	tibial spur
tgl	tegula

tmp	temple
tor	torulus
tps	transepimeral sulcus
trb	trabecula
ts	terminal spine
tsa	transscutal articulation
tss	transepisternal sulcus
uep$_2$	upper mesepimeron
ues$_2$	upper mesepisternum
unc	uncus
upf	upper face
vls	volsella
vpl	ventral plaque
vrt	vertex
vs	vertexal suture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scd
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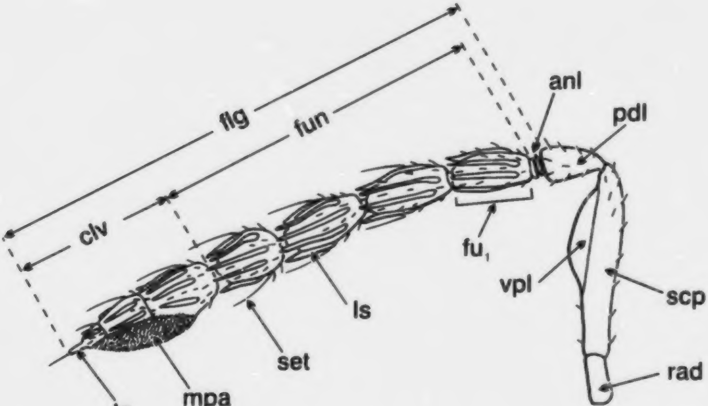
tor
iaa
poc
pgs
msl
lower face
gen
sca
msp
atp
mdp
cly
lbr
man

1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flg
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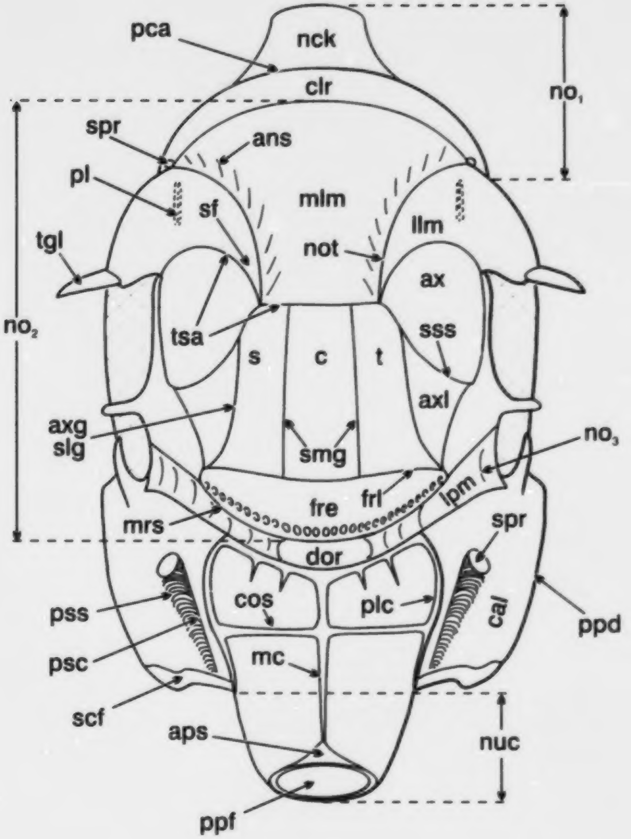
ls
set
rad
mpa
ts

2

Figs. 1–2. Composite chalcidoid: 1, head; 2, antenna.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slg
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lpm
frl
fre
mrs
spr
dor
pss
cos
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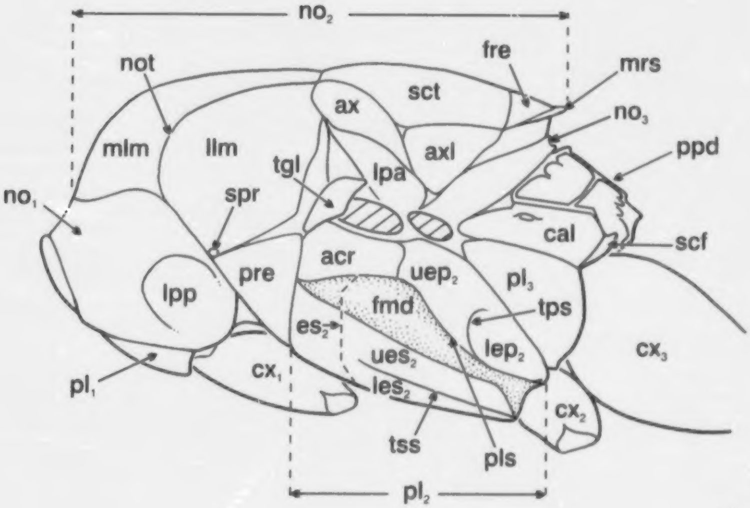
3

Fig. 3. Composite chalcidoid mesosoma (dorsal).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pl₃
lpp
fmd
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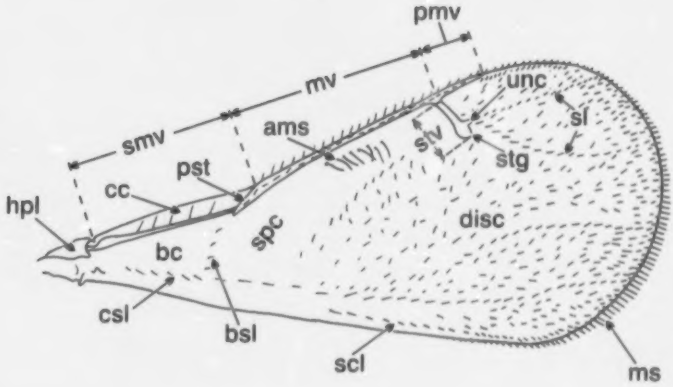
pls
pl₂

4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hpl
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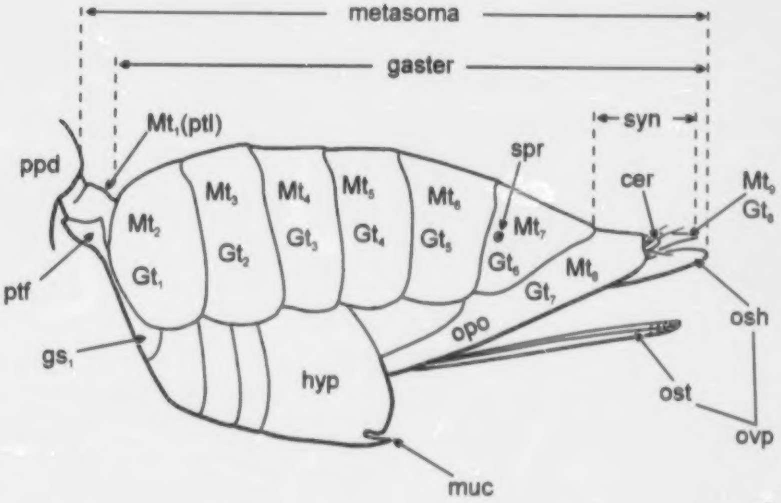
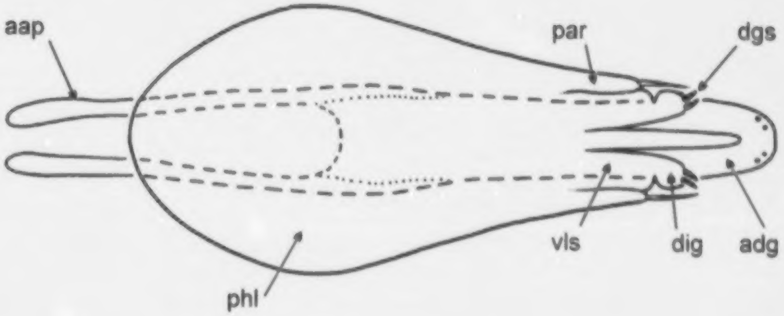
5

Figs. 4–5. Composite chalcidoid: 4, mesosoma (lateral); 5, forewing.

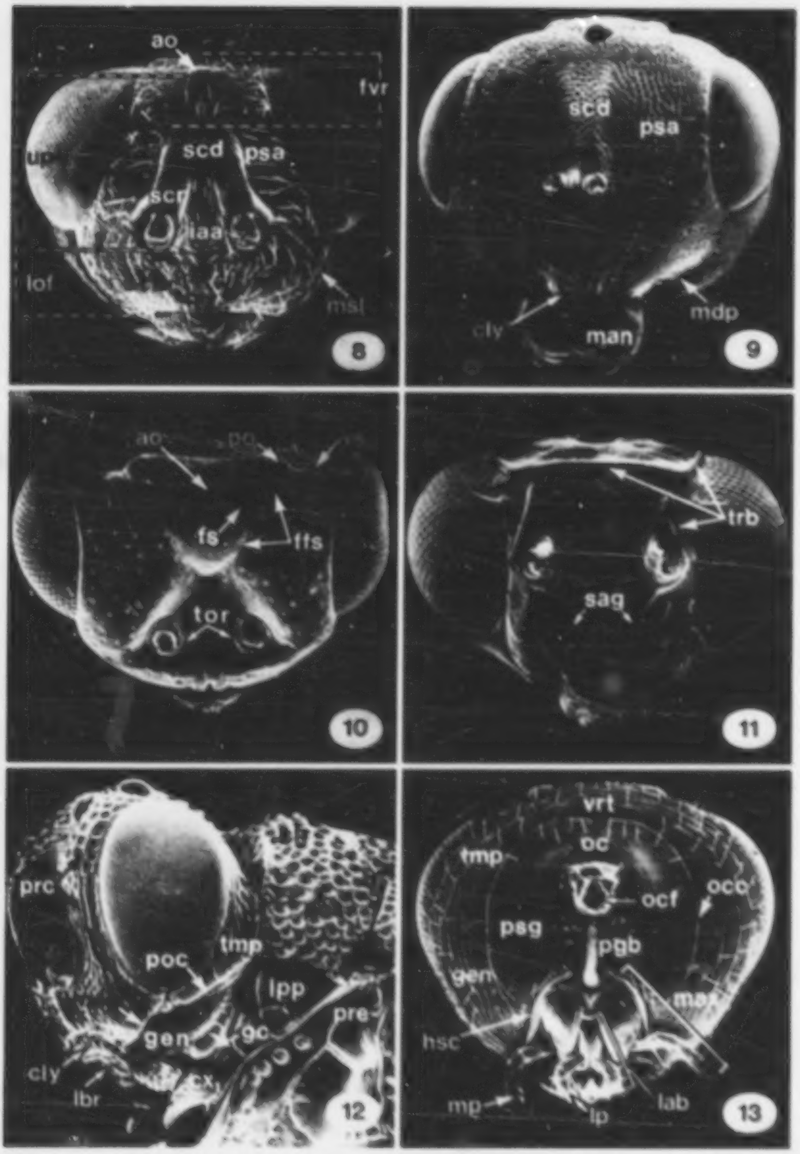

metasoma
gaster
Mt$_1$(ptl)
syn
spr
ppd
cer
Mt$_9$
Gt$_8$
Mt$_3$
Mt$_4$
Mt$_5$
Mt$_6$
Mt$_2$
Gt$_1$
Gt$_2$
Gt$_3$
Gt$_4$
Gt$_5$
Mt$_7$
Gt$_6$
Mt$_8$
Gt$_7$
ptf
osh
opo
gs$_1$
hyp
ost
ovp
muc

6


aap
par
dgs
vls
dig
adg
phl

7

Figs. 6–7. Composite chalcidoid: 6, metasoma (lateral); 7, ♂ genitalia.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trb
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11
prc
tmp
poc
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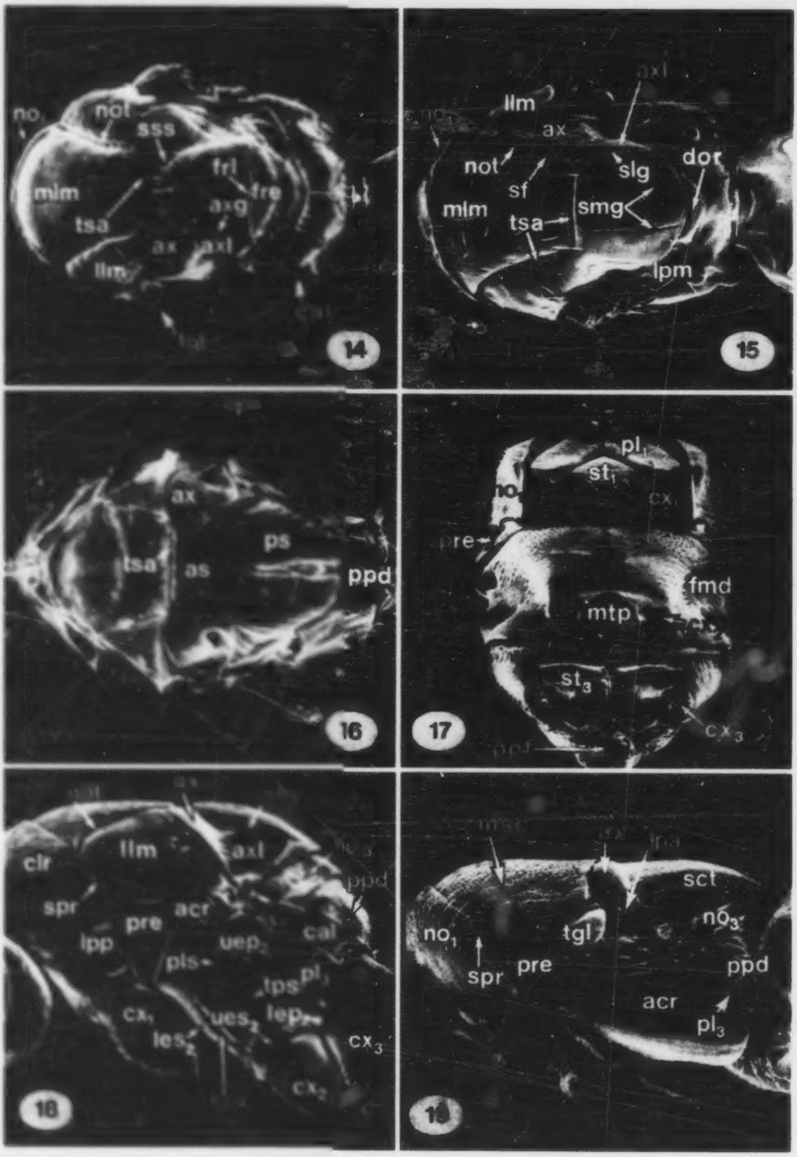
pre
gen
gc
cly
lbr
cx
12
vrt
oc
tmp
oco
ocf
psg
pgb
gen
max
hsc
lab
mp
lp
13

Figs. 8–13. 8–11, head: 8, ***Eupelmus amicus*** Girault; 9, ***Catolaccus***; 10, ***Crataepus marbis*** (Walker); 11, ***Gonatocerus morrilli*** (Howard). 12, head and pronotum, ***Brachymeria***. 13, head (posterior), ***Ormyrus***.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tsa
lpm
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ps
tsa
as
ppd
16
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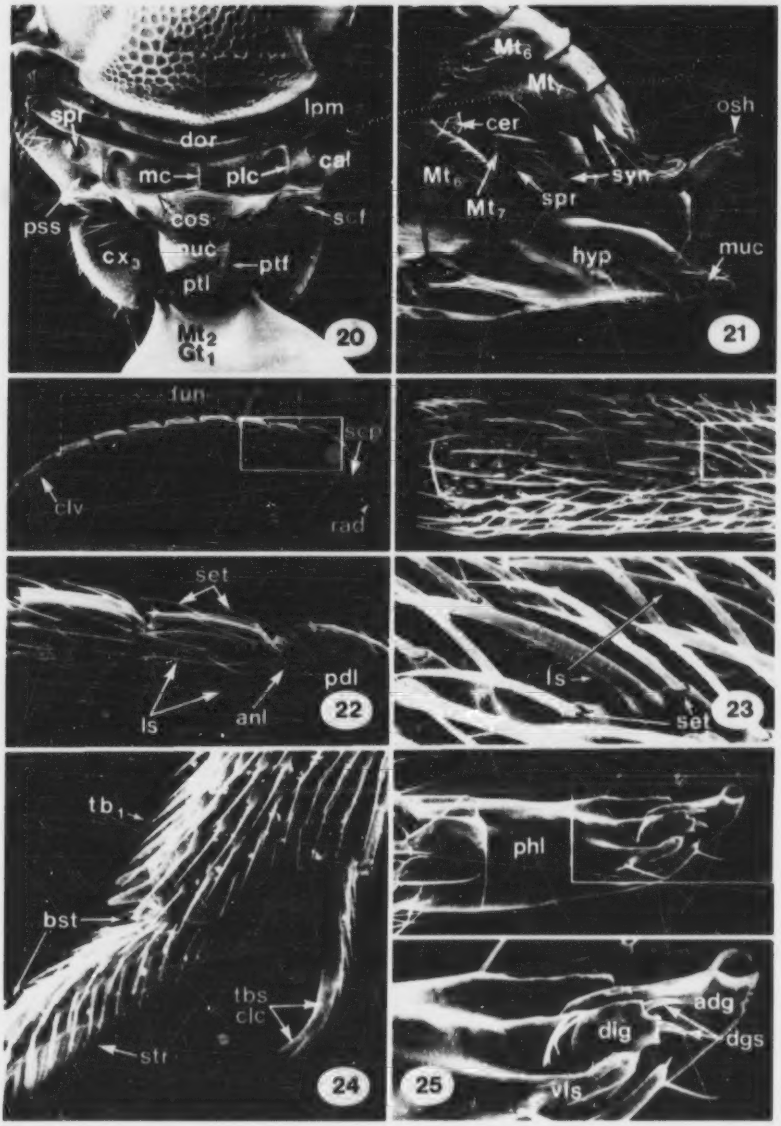
st_1
cx_1
pre
fmd
mtp
st_3
cx_3
17
ax
llm
axl
clr
spr
pre
acr
ppd
lpp
uep_2
cal
pls
tps
pl_3
cx_1
ues_2
lep
les_2
cx_3
cx_2
18
sct
no_1
tgl
no_3
spr
pre
ppd
acr
pl_3
19

Figs. 14–19. 14–16, mesosoma: 14, ***Seladerma***; 15, ***Baryscapus coerulescens*** (Ashmead); 16, ***Schizophragma***. 17, mesosoma (ventral), ***Podagrion mantis*** Ashmead. 18–19, mesosoma (lateral): 18, ***Neotrichoporoides***; 19, ***Prionomites***.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Gt_1
20
Mt_6
Mt_7
osh
cer
syn
Mt_6
Mt_7
spr
hyp
muc
21
fun
scp
clv
rad
set
pdl
ls
anl
22
ls
set
23
tb_1
bst
tbs
clc
str
24
phl
adg
dig
dgs
vls
25

Figs. 20–25. 20, scutellum–base of metasoma, ***Propodeia***. 21, apex of metasoma (lateral), ***Prionomites***. 22, antenna, ***Reikosiella***; 23, funicular sensilla, ?***Anastatus***. 24, apex of protibia–basitarsus, ***Epistenia***. 25, ♂ genital capsule (ventrolateral), ***Eupelmus***.

Chapter 3. **CHALCIDOIDEA**

E. Eric Grissell and Michael E. Schauff

Introduction. The superfamily Chalcidoidea is one of the most abundant, speciose, and biologically diverse groups of insects. Published figures indicate that about 18,600 valid world species are known in over 1,900 genera (Noyes 1990*a*) and that Chalcidoidea account for roughly one-third of the world's number of parasitic species of Hymenoptera (LaSalle and Gauld 1991). This estimate is undoubtedly conservative, and it has been estimated that there may be between 60,000 and 100,000 species of Chalcidoidea (Noyes 1978, Gordh 1979). The most recent count for the Nearctic region listed over 2,220 described species in 490 genera (Krombein et al. 1979), but based upon tallies made from the work at hand the current figure would more nearly approach 3,000 species in 706 genera.

Chalcidoidea clearly represents a significant portion of the biological diversity found in terrestrial ecosystems and they play a major role in regulating populations of terrestrial insects. Most Chalcidoidea are parasites of other insects and they have been used extensively in the biological control of insect pests. In fact, the majority of successful biological control projects of insect pests have used chalcidoids to achieve substantial or complete control (Greathead 1986).

Because of the relative abundance of chalcidoid taxa (many of which are undescribed), their worldwide distribution, complex biological interactions, often baffling morphological diversity, and the few taxonomists who have studied the superfamily, much research remains to be undertaken. Whereas reasonable attempts have been made to document the north-western European and Australian faunas, surprisingly little comprehensive research has been undertaken in the Nearctic region over the past 100 years. This picture has changed in the past 10 years as the present work on Nearctic genera of Chalcidoidea will clearly demonstrate. Although Howard (1885–86) began a key to the genera of Nearctic Chalcidoidea he never finished it. Ashmead's (1904) world revision of genera, however it is viewed today, was a monumental leap forward for the New World fauna. The present work is the first comprehensive set of illustrated keys for the Nearctic region.

Recognition. Under field or even laboratory conditions, many Chalcidoidea are likely to be confused with two other groups of insects: small flies and other small wasps. Chalcidoids, being Hymenoptera, have two sets of membranous wings (except wingless species, see below) as opposed to the single set found in flies. Among wasps, chalcidoids are characterized by their much reduced wing venation. Most other Hymenoptera not only have many veins on the forewing, but they have several (or many) closed cells. In the chalcidoid forewing no cells are completely surrounded by veins (Fig. 1, note that the costal cell has no vein on the anterior edge). There is at most only one principal vein that is branched at the end (into postmarginal and stigmal veins), though often the postmarginal is absent or the stigmal is reduced or, rarely, only the submarginal vein remains.

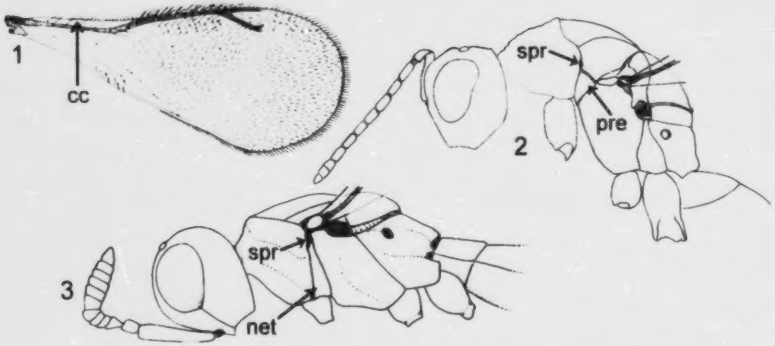
Among wasps, chalcidoids are most likely to be confused with the family Scelionidae (Platygastroidea) because of similar wing venation. Although distinctions between these taxa are technically clear, they are somewhat difficult to see. Almost all chalcidoids have a sclerite called the prepectus (Fig. 2) between the base of the forewing and the pronotum. Platygastroids lack this sclerite, although a similar looking area, called the netrion, is often present on the pronotum of Scelionidae (Fig. 3). Thus, in chalcidoids the base of the forewing usually appears to be separated from the lateral corner of the pronotum (Fig. 2), but in Scelionidae the base of the forewing appears to touch the corner of the pronotum (Fig. 3).

Much more difficult to see, but more reliable as a diagnostic character, is the placement of the mesothoracic spiracle. In chalcidoids the mesothoracic spiracle, when visible, is located between the pronotum and the exposed lateral edge of the mesoscutum, mostly above the anterodorsal angle of the prepectus (Fig. 2) and far from the anterior margin of the mesopleuron, whereas in platygastroids the spiracle is lower down, either between the posterior margin of the pronotum and the anterior margin of the mesopleuron (Fig. 3) or on the pronotum in the same relative position.

Most Chalcidoidea also share a character found on the antenna, namely the presence of longitudinal sensilla. These elongate sensilla are raised above the surface of the antenna and, in addition, the apex is free from the surface. Platygastroids do not have such sensilla (see Gibson 1986 for details).

In the case of a few wingless chalcidoids, the above three characters are the only technically accurate methods to separate them from platygastroids.

Coloration may be used with some caution to distinguish nearctic chalcidoids from platygastroids. Many chalcidoids tend to be metallic or have mixtures of colors such as black and yellow. In North America no metallic platygastroids are yet known; they are most often black or uniformly brown or yellowish. Any metallic small wasp is most likely to be a chalcidoid, but small, black-colored wasps should be identified based upon the morphological features discussed above.



Figs. 1–3. 1, chalcidoid forewing. 2, chalcidoid body (lateral). 3, scelionid body (lateral) [net = netrion].

Systematics. As noted above, Chalcidoidea is a diverse group with a vast array of morphologies and, although a large number of species have been described, the study of the group may still be regarded as being in its infancy. The great bulk of existing literature is descriptive in nature, and there are very few detailed revisionary studies of the major groups within the superfamily. Bouček (1988*b*) reviewed the history of the higher classification of Chalcidoidea and noted that anywhere from 24 (Nikol'skaya 1952) to nine (Riek 1970) families had been recognized. He summarized his findings thus: "For a stabilized system [of classification] it is necessary to have clear definitions of all families based on characters which would withstand any deep analysis, cladistic or other. In this respect, however, very little has been done so far and the pattern of relationships is still partly vague."

Our knowledge of evolutionary relationships among chalcidoids is in many respects the same today as it was since the early 1900's. Families have been defined on the basis of similar morphologies, but some have become dumping grounds for taxa that cannot be conveniently placed in a well-defined group (Pteromalidae is perhaps the best example). Only recently have workers begun to apply phylogenetic methods to the question of relationships among chalcidoids. Very few groups have been shown to be monophyletic, and for those that have (e.g., mymarids, tanaostigmatids), their relationships to other chalcidoids remain a topic of much discussion and research. Some groups, such as Trichogrammatidae, would seem to be monophyletic, but a thorough analysis of the evidence for monophyly has not yet been published. Other families, such as Aphelinidae, are likely paraphyletic (or polyphyletic), but careful research and analysis of characters have not been completed. Nonetheless, progress is being made, and many of the authors of this volume are engaged in studies that should eventually shed some light on relationships among the major groups.

It is not our intent to give an in-depth discussion of the current state of chalcidoid relationships, but rather to provide a brief overview. The family names used in the body of this work are, for the most part, those that were established by early workers and are used in much the same context. Some, such as Elasmidae and Aphelinidae, have had their usage and affinities changed several times in recent decades. Some of the family names will undoubtedly stand the test of time, whereas others will certainly fall as character systems are more carefully studied and analyzed. In this manual we adopt a consensus view of its participants and recognize 19 families of Chalcidoidea.

Recent work suggests that Mymarommatidae is the probable sister group of Chalcidoidea (Gibson 1986), but there is still debate as to whether mymarommatids should be classified within the Chalcidoidea (Naumann 1991) or as its own superfamily (Noyes and Valentine 1989, Gibson 1993). Members of this rare and enigmatic group, which key out at couplet 1, appear platygastroid-like based upon external features but based upon internal features they appear chalcidoid-like (Gibson 1986).

Within Chalcidoidea, interrelationships are not well understood, and workers sometimes refer to 'lines' or lineages of families to indicate groupings of taxa that seem to be related. One group that has been investigated in some detail is the Encyrtidae/Eupelmidae/ Tanaostigmatidae complex whose members share several derived features, though the shared features may have been derived independently (LaSalle 1987, Gibson 1989). Other workers refer to the 'eulophid line' (Eulophidae, Signiphoridae, Aphelinidae, Elasmidae, Trichogrammatidae) or 'pteromalid line' (Pteromalidae, Eucharitidae, Perilampidae, etc.), but these lineages have not been shown to be natural groups. In fact, evidence is accumulating that at least some lineages are not monophyletic. Much work remains to be done and it likely will be many years before higher level relationships are clearly understood.

Biology. Chalcidoid biology is a study in diversity that is exemplified by its broad spectrum of hosts, its extensive variety of feeding types, and an often bewildering complexity of behavioral interactions even within a single species. It has been said that this group of parasitic and phytophagous wasps "...parasitize more hosts in more different taxonomic categories than any other group of parasitic insects" (Gordh 1979). Eggleton and Belshaw (1992), however, presented evidence that Diptera parasitize a wider host range than any other group of insect parasites. Although it is somewhat difficult to document such statements given the enormous number of insects and their diversity, we suggest that the Chalcidoidea is among the most biologically diverse groups of parasitic insects. The remainder of this section provides some background information to the biological diversity found in Chalcidoidea. It should be emphasized that our knowledge of true biology, as opposed to 'host association' or 'host data', is really quite poor, and Noyes (1994) pointed out that even host data can be so "misleading as to be generally useless".

Host Range. Chalcidoids are known to attack hosts from 13 orders of Insecta (Coleoptera, Diptera, Hemiptera, Homoptera, Hymenoptera, Lepidoptera, Neuroptera, Odonata, Orthoptera, Psocoptera, Siphonaptera, Strepsiptera, and Thysanoptera), as well as egg sacs of spiders (Araneae), ticks and gall-forming mites (Acari), cocoons of pseudoscorpions (Pseudoscorpiones), and gall-forming Anguinidae (Nematoda). In addition, a number of species of Chalcidoidea are phytophagous. The family Tanaostigmatidae is believed to be entirely phytophagous, either as gall-formers or as inquilines in galls. The Agaonidae are all associated with figs (*Ficus*) as gall-formers or seed-feeders in fig flowers, though some may be inquilines (Bouček 1988*a*). Several families of Chalcidoidea are only partially phytophagous, having genera in which all species are obligate plant feeders (e.g., some Eurytomidae, which are gall-formers in grass stems) or that have both seed feeding and parasitic species in the same genus (e.g., some Eurytomidae, some Torymidae). Even single species are known to feed on both insect and plant tissue. This is especially true for parasites of gall-forming insects (e.g., Eurytomidae, Torymidae).

One of the most comprehensive and inclusive overviews of the subject of chalcidoid biology is that of Bendel-Janssen (1977), who cited nearly 700 papers in her review of their biology, ecology, and ethology. Clausen's (1940) book on entomophagous insects, and Askew's (1971) book on parasitic insects, are also two particularly useful references on the subject. Gordh (1979) also gave an excellent short overview of chalcidoid biology.

Feeding Types. In addition to their remarkably broad host range, the variety of feeding types found in Chalcidoidea is considerable. Hagen's categorization of feeding types (1964: 219–220) in parasitoids is useful to illustrate this variety. We use his classification, with some modification, to demonstrate the potential scope of feeding patterns found in Chalcidoidea:

Egg laid away from host

1. Egg hatches before host contact, and larva must locate host, or host must come to larva. This behavior is typical of the families Eucharitidae and Perilampidae, which lay eggs in or on plant parts (leaves and buds, the site being specific for different parasite species); the emerging larvae either wait for a host or move some distance to find a host.
2. Egg hatches after ingestion by host. This type of feeding, characteristic of the Trigonalyidae, is not yet known in Chalcidoidea.

Egg laid among host eggs, larvae, or nymphs

3. Egg hatches and larva feeds as predator. This form of feeding is found in many Chalcidoidea, including Eulophidae, Eupelmidae, Encyrtidae, Eurytomidae, and Pteromalidae. The larvae are somewhat mobile and often attack multiple hosts in an enclosed environment such as eggs within a spider egg-sac or nematodes or immature mites within galls.

Egg laid in host egg

4. Larva develops in single egg. This feeding type is represented by Trichogrammatidae and Mymaridae, which are exclusively egg parasites. Other families that have a few species with this habit include Eulophidae, Encyrtidae, Pteromalidae, Eupelmidae, and Torymidae.
5. Larva eats egg (i.e., is a parasite) then moves to other eggs (i.e., is a predator). This is a relatively uncommon feeding type exhibited by several species of Eulophidae, Pteromalidae (Eunotinae), and Encyrtidae.
6. Larva does not feed until host develops into larva or pupa (i.e., egg-larval or egg-pupal parasite). This is uncommon, but is known in Encyrtidae, Torymidae, and Eulophidae.

Egg placed on host larva or pupa (ectoparasite)

7. Larva develops on host concealed in cocoons, puparia, mines, galleries, galls, scale covers, etc. This is probably the most common form of parasitism and is found in all families but Agaonidae, Mymaridae, Tanaostigmatidae, and Trichogrammatidae.
8. Larva develops on free-living, unconcealed host. Only a few Eulophidae demonstrate this feeding type on larvae of Lepidoptera.
9. Larva enters host to complete development. Only Aphelinidae displays this feeding type. In this case male eggs are placed on female larvae of the same species.

Egg placed in host (endoparasite)

In larvae of holometabolous insects

10. Larva develops in host larva. This feeding type is known for only a few Eulophidae.
11. Larva develops in host pupa (i.e., larval-pupal parasite). This feeding type is known in some Chalcididae, Eulophidae, Pteromalidae, Encyrtidae, and Eurytomidae.

In nymphs or adults of hemimetabolous insects

12. Larva develops in nymphs or adults. Only Aphelinidae and Encyrtidae (*Hexacladia*) display this feeding type. Emergence from adult host is associated with female scales, mealybugs, or true bugs.

In pupae of holometabolous insects

13. Larva develops in host pupa. Some members of the Pteromalidae, Chalcididae, Torymidae, and Eulophidae show this feeding type.

In adults of holometabolous insects

14. Larva develops in host adult. Only a few species of *Tomicobia* (Pteromalidae) and *Phymastichus* (Eulophidae) display this form of feeding.

Egg placed according to sex of parasite egg

15. Developmental site determined by mated status of female. This complicated feeding type occurs only in Aphelinidae. Depending upon state of egg fertilization, females either place eggs on or in host (ectoparasitic versus endoparasitic), or place eggs on primary host (females) or as hyperparasites (males) in same host, or place eggs on different hosts.

Of the above 15 categories, chalcidoids are excluded only from category 2 (eggs hatch after ingestion by host). Incorporated into the above list are categories that are not immediately apparent, but are noteworthy on their own. These factors, when combined and permutated, allow for greatly increased methods of adaptive exploitation. Endoparasitism and ectoparasitism (i.e., internal and external feeding) are different methods of exploiting host tissue that must have arisen because each confers some inherent advantage. Similarly, idiobiont (inactivated host) and koinobiont (active host) lifestyles increase the ways that hosts may be used, and the same may be said for the production of solitary or gregarious progeny. Hyperparasitism is common in many chalcidoid families and may rarely extend to an obligate tertiary level, though the secondary level is most common (Askew 1971). In some forms (e.g., adelphoparasitism), hyperparasitism involves some fairly complex adaptations to parasitism as discussed in the next section. Some species of chalcidoids are hyperparasitic in an obligate manner, whereas others are facultative, perhaps allowing for greater flexibility in adapting to specific host situations. Askew (1971) demonstrated facultative hyperparasitism to the fifth level in gall communities and showed that some chalcidoids will feed upon larvae of any species, including their own.

Based upon the functional classification outlined by Hagen (1964), chalcidoids are the only group of parasites that exploit virtually every feeding opportunity in nearly every manner possible for a parasite. Additionally, some chalcidoids are obligatory phytophages (e.g., seed-feeders, gall-formers), and some are omnivorous in either a facultative or obligate manner.

Complexity of Behavior. In addition to factors of host range and type of feeding, some components of behavior should be considered as factors that increase biological diversity within Chalcidoidea. For example, Salt (1941) demonstrated that progeny of a species of *Trichogramma* reared from different sized host eggs resulted in adults that differed not only in size or sex but also in behavior. Large adults parasitized hosts almost twice as fast, had a higher reproductive potential, and could parasitize larger hosts than could the smaller progeny. The effect that this plasticity has on biological adaptation and diversity is unknown.

Other subtle behavioral nuances are known for which we have little understanding. For example, Bryan (1983) reported that differences in sex ratio, brood size, and host age in some eulophid species were due to changes in oviposition behavior of females of different generations. Askew (1961) demonstrated that the spring generation of a torymid species had females with short and long ovipositors, but in the fall generation only short-ovipositor morphs were present. Ovipositor length was apparently correlated with host size and availability. In both cases, there appear to be some as yet unknown behavioral and generational components of host selection.

Chalcidoids have complex reproductive capabilities, and we do not fully understand the relationships of reproduction to host selection. All chalcidoids have a haploid-diploid method of reproduction, and two basic types of reproduction occur: arrhenotoky and thelytoky (a third, deuterotoky, appears to be simply a form of thelytoky). Arrhenotoky is most common; unmated females lay only haploid eggs that develop into males, whereas mated females have the option of laying fertilized eggs that develop into females or unfertilized eggs that develop into males. Thelytoky is parthenogenesis in which males are unknown, or rare, and females produce females asexually.

Perhaps the most complex expressions of arrhenotoky and thelytoky in Hymenoptera are found in Chalcidoidea, especially the families Trichogrammatidae and Aphelinidae. In species of *Trichogramma* and *Encarsia perniciosi* (Tower), research has shown that thelytoky is induced by the presence of microorganisms and that heat and antibiotics will return a thelytokous strain to arrhenotoky (Stouthamer et al. 1990, Stouthamer and Luck 1991). In the case of some arrhenotokous *Encarsia*, male eggs are deposited internally in eggs of Lepidoptera, but female eggs are placed internally in scale insects (Coccoidea). In some species of *Coccophagus*, males are ectoparasites, whereas females are endoparasites in the same host species. In some thelytokous species of *Encarsia*, *Coccobius*, and *Coccophagus*, the uncommon males develop as internal hyperparasites of larval females of their own species (autoparasitism). Comprehensive reviews of this topic are provided by Flanders (1967) and Walter (1983*a*, 1983*b*).

Overview of Biological Relationships. It is difficult to make a single statement about biological relationships within the Chalcidoidea that will be true all of the time. Families, genera, and species of chalcidoids may be classified as specialists, generalists, or opportunists, depending in part upon the hierarchy of the category being examined. For example, the families Mymaridae and Trichogrammatidae are specialists in that all species (so far known) are endoparasites of insect eggs. Other specialist families include the Agaonidae — pollinators or associates of figs (*Ficus*), the Leucospidae — all parasites of bees and wasps (Apoidea), and the Tanaostigmatidae — all phytophagous.

Within some families, specialization may take place at the generic level. For example, in Eurytomidae, species of *Tetramesa* are gall-formers in grass stems, whereas those of *Bruchophagus* are seed-feeders, and those of *Rileya* are parasites of Cecidomyiidae. Within Trichogrammatidae and Mymaridae some genera are specialists on certain groups of eggs, such as those of Homoptera, Lepidoptera, or Bruchidae. But even so, species within one of these specialist genera may display some habitat-specific, rather than host-specific, behavior. For example, a given *Trichogramma* species might be able to oviposit into numerous kinds of eggs of Lepidoptera in different habitats, such as eggs associated with grass stems, or oak leaves, or aquatic vegetation. The same is true of some chalcidoid genera that attack, for example, leaf-mining or gall-forming insects. The insect in the leaf mine might be a species of Lepidoptera, Diptera, or even another Hymenoptera, but the chalcidoid develops as long as the habitat is appropriate.

Rarely, single chalcidoid species are opportunists reared from many insect orders in many habitats. This behavior may be found, for example, in *Dibrachys cavus* (Walker) (Pteromalidae) or *Eupelmus vesicularis* (Retzius) (Eupelmidae), which parasitize a broad array of hosts. More commonly, families demonstrate an extremely polyphagous nature, making it difficult to categorize their feeding patterns in a simple way. Encyrtidae, for example, parasitize a wide diversity of groups from Ixodidae (Acari) to Coleoptera, Aphididae and Coccoidea, Lepidoptera, adult Hemiptera, and even each other. Torymidae are perhaps more diverse, some are phytophagous in seeds and others attack a broad spectrum of Hymenoptera, a few Lepidoptera, a few Coleoptera, a number of Cecidomyiidae (but few other Diptera), Strepsiptera, eggs of Mantidae, and a few Hemiptera. Similar broad spectrum patterns are also found in the Pteromalidae, Eupelmidae, and Eulophidae.

Collecting, Mounting and Labeling. The specialized subject of collecting and mounting chalcidoids was discussed thoroughly in two papers by Noyes (1982, 1990*b*). In this section we do not explain all the generalized equipment or techniques used in collecting insects, because this information is available in most introductory books on insects. Instead, we explain methods of applying techniques and equipment specifically to Chalcidoidea.

Collecting. Chalcidoids may be collected by using three broadly defined methods: rearing, active sampling (e.g., sweeping, beating, vacuuming), and passive sampling (trapping). Each method has its own advantages and special uses, but in general all methods should be used when possible.

1. Rearing. This yields the most information. Not only is something learned about the habitat and host association of specimens obtained, but males and females may be positively associated and large numbers of specimens may be obtained with which to study variation. Such material leads to a better understanding, or characterization, of a species. Additionally, knowledge of the host of a parasitic or phytophagous species aids in identification. For example, a chalcidoid reared from an egg of Lepidoptera almost certainly will be a trichogrammatid, eulophid or eupelmid, from a scale or mealybug (Coccoidea) most likely an encyrtid or aphelinid, and from an ant pupa (Formicidae) a eucharitid or eulophid.

True host associations may be more subtle than first observation would indicate. For example, leucospids are sometimes reared from galls of Cynipidae. Careful examination, however, reveals that their true hosts are stinging wasps or bees (Aculeata) that reuse the old galleries of galls from which cynipids have previously emerged.

Discussion of rearing methods is beyond the scope of this book, and generally simply reflects degrees of refinement of simple techniques. The simplest method of rearing is to gather up host material and place it in a plastic bag, jar, or box. For example, a collection of rose hips, acorns, flower-heads, plant stems, etc. can be placed in a container. Sometimes nothing emerges. Sometimes large numbers of insects of many families emerge or sometimes great numbers of a single species. This is a coarse level of rearing which can yield many specimens for study, but which also results in a low level of knowledge about the host. For example, in the case of rose hips one may rear parasites from hosts on the surface (e.g., scales, or insect eggs of any number of orders), from the pulp of the hip (e.g., larvae of boring Lepidoptera, Diptera, or Coleoptera), or from the seeds (e.g., a true seed-chalcid, or parasite of the seed-feeder).

Relatively crude rearing provides a quick assay of a community, but is not refined enough to ascertain true host relationships. To continue with the example of rose hips, the seeds might be extracted and placed in individual gelatin capsules separate from the pulp. This technique determines exactly what came out of each seed as opposed to the pulp. Still unknown would be what actually went on inside the seed — a community in itself. Ultimately it would be necessary to dissect each seed and study the interactions of all the life-forms present; only then will the precise association of wasp to host be known.

Rearing can be as easy or difficult and as gross or precise as the situation warrants. Rearing parasites from mature or quiescent hosts simplifies matters and eliminates the process of rearing and feeding the host long enough to obtain its parasites. For example, mature scales, seeds, fruits, galls, shelf fungi, twigs, mines, eggs, or pupae do not require much investment in active maintenance to obtain results. Sometimes parasites emerge the same day the host is collected, whereas seed-feeders may take one to three years to emerge.

With active larvae or other immature hosts, however, it is necessary to feed and maintain the host long enough for the parasite to develop. Often this requires specialized conditions such as fresh host-plant material or environmental controls to induce or break diapause. It also takes a great amount of time and space to do this, especially if a number of different hosts are involved.

One way to begin rearing chalcidoids is to work from the known host ranges, that is, to collect hosts that are known to harbor parasites. This information may be obtained by consulting the host lists in publications such as Peck (1963) or Krombein et al. (1979). It is known, for example, that chalcidoid species have been reared from wild rose seeds or gypsy moth pupae. If the object is to make a new host discovery, then the unknown becomes the necessary searching ground. Confining poison oak seeds, damselfly naiads, or any of a thousand other hosts for which no records are known must be undertaken.

2. Active sampling. This refers to collecting in the traditional sense of actively pursuing the prey with nets or beating trays. This is often a wholesale approach to gathering specimens, because one usually does not know what has been collected until the sample is returned to the lab and sorted. It is possible to infer some biological information about a chalcidoid when collecting in this fashion, but such information is often rather limited.

Nets for collecting chalcidoids should be constructed of fine mesh cloth such as nylon chiffon or silkscreen fabric to prevent specimens from escaping through the mesh, as happens with nets typically used for butterflies or larger insects. Sweep nets made of muslin or sailcloth may also be used. With the traditional net method, chalcidoids are rarely 'chased-down' like butterflies. Instead the net is used as an imaginary broom to 'sweep' habitats of interest. The simplest method is to sweep a selected habitat, choke the net bag, and put its end temporarily into a large killing bottle. The resultant mass, which is often contaminated with sticks, stems, leaves, and seeds, must then be sorted through to pick out the desired specimens. Specimens collected in this manner may be dry, somewhat brittle, and generally must be sorted the same day as collected. For many families in which the body is poorly sclerotized, this treatment results in specimens that are badly shrivelled and therefore of lesser scientific value. In addition, spiders and other predators may damage specimens or (in the case of webbing) make the sample difficult to sort.

A variation on this technique is to dump the contents of the bag into a large jar containing some alcohol (preferably ethanol). This must be done quickly, not only to prevent specimens from flying out, but also to avoid being stung by aculeates that were caught while sweeping. Material in ethanol can be sorted at almost any time, even long after collecting (such material should be stored in 70% ethanol, in a freezer if possible, to reduce discoloration and deterioration). This wet method is generally better for specimens than the dry method, as will be explained later under 'Mounting'. Methods for sorting insects from plant material have been investigated by Zolnerowich et al. (1990).

Variations on the above techniques are certainly possible. For example, a beating sheet or vacuum device could be used instead of an insect net. Also, specimens may be removed from the net by several means. One method is to use an aspirator (suction device) to pick out only the specimens of interest.

Because the specimens are still alive, this requires holding the net so that material does not escape, finding what you want, getting the aspirator to it, and sucking up the specimen. Some dexterity, agility, and coordination are required, but this process is aided by the tendency of most chalcidoids to walk towards light. Another method is to quickly invert the net bag into a trap or light box of some type in which the specimens work their way from the dark interior of the box (or trap) towards the light (usually into a collecting tube or fine mesh bag of some sort). Masner and Gibson (1979) describe one such device in detail.

Refinements of the general sweeping technique are possible and they may give some indication of biological relationships. If possible, begin sweeping in as narrow a habitat type as can be defined. In a woodland-savannah, begin by sweeping a single tree. Then sweep more of the same tree species until it is apparent that nothing new is being found on that tree. Repeat with other species of trees. Then sweep shrub species, individual species of herbaceous plants, or species of grasses. In so doing, it is possible to gain some potential biological data otherwise overlooked by broad-scale sweeping. For example, sweeping a single species of composite in bloom can yield quantities of parasites of Tephritidae or Cecidomyiidae (often the potential host is swept at the same time), sweeping an oak can produce numerous parasites of Cynipidae, and sweeping holly can produce huge numbers of holly seed-feeding chalcidoids.

Frequently, little is collected by sweeping in this narrowly defined manner, or one ends up with a few isolated specimens of no interest. One can then try a broader approach. For example, at some point it pays to sweep habitat types. That is, sweep foliage of trees and shrubs, pond-side grasses and sedges, upland grasses, herbaceous fields, or grazed pastures. By doing this one can often obtain numerous species of chalcidoids that are defined only as 'grass inhabiting' species or 'woodland' species. It is also known that different strata of the same habitat produce different species of wasps. For example, wasps found on ground-level grasses (grazed or mown) may be different from wasps found at the tops of tall grasses in the same habitat.

Rarely one finds a special sort of collecting site that is good in terms of quantity and diversity, but is not particularly informative biologically. These areas may yield specimens of nearly every chalcidoid family. Such collecting sites are ones that provide abundant nectar or honeydew in a restricted habitat. A small patch of flowers blooming in the midst of an otherwise dry field may attract chalcidoids for some distance from the surrounding countryside. Small-flowered plants such as *Baccharis*, *Eriogonum*, *Euphorbia*, or Apiaceae are particularly good. A spring, seep, leaking horse trough, or cloudburst puddle in the middle of a desert or along the drainage of a dry road is often rich in material if plants have sprung up in response to the moisture. A tree or shrub full of honeydew-producing Aphididae can be exceedingly rich for a diversity of wasps that have no interest in the aphids themselves. Some plants, having extrafloral nectaries that attract throngs of chalcidoids, are easily overlooked because there is no showy flower to be seen from a distance. A highly disturbed site, full of blooming 'weeds,' can be an attraction to chalcidoids, even if few other native plants are blooming in the area. These types of sites attract all sorts of Hymenoptera, but finding them is often a matter of chance. Occasionally one may find such a site every few days during extensive collecting periods. When this happens, it is best to take advantage of the situation and to collect as much material as possible.

3. Passive sampling. This form of collecting relies on unattended devices (traps) that collect continuously. Traps can be incredibly productive, working 24 hours a day and allowing the collector to sample actively many habitats in the meantime. However, the traps must be transported, set up, regularly serviced, and repaired. Traps may be stolen, trampled by cattle or other large animals, run over by off-road vehicles, vandalized, flooded, or may simply fall apart due to weathering.

There are numerous types of insect-collecting traps. References that describe different collecting techniques and traps include Steyskal et al. (1986), Martin (1977), and Marshall et al. (1994). Noyes (1989) and Marshall et al. (1994) discussed the merits of different sampling methods (including sweeping), and cited papers concerning specific traps and their value. Although Noyes (1989) concluded that "for most groups of Hymenoptera, sweeping was the most effective single method of sampling," he also stated that sampling should be "conducted using as wide a variety of methods as possible because every method undoubtedly has at least one advantage over any other."

The traps that seem to work best for chalcidoids are the flight-interception devices (e.g., Malaise trap, windowpane trap) and the yellow-pan or Moericke trap. Not surprisingly such traps work well in tandem. Darling and Packer (1988) concluded that "pan traps are an important component of an efficient Malaise trap." They also determined that a fine-mesh, concolorous trap was better for collecting microhymenoptera than a bicolored trap of coarse mesh. Other types of traps may be used, but we have found them to be less productive than the ones just cited. Light traps and pitfall traps rarely produce large numbers of specimens, but may on occasion yield a few exceptional species. Fig wasps, for example, are particularly attracted to light traps and may be collected in large numbers. Berlese or Winkler funnels/extractors might prove useful for some groups that are wingless (e.g., Diparinae), but technically these devices might not be considered traps because material has to be brought to them in the form of soil litter, duff, moss, etc.

Mounting. For the most part, chalcidoids are too small to be mounted directly on insect pins. Mounting techniques may be improvised to the point of extreme, but the result should be to secure the specimen to a substrate that allows complete examination from all angles. This is often difficult at best, but is impossible in the case of slide-mounted material which requires a two-dimensional plane for best visibility.

A very few Chalcididae, Leucospidae, or Pteromalidae might appear large enough to pin, but the thorax will often break if this is attempted. Most chalcidoids should be point- or card-mounted. In this case the specimen is glued by the right side of the thorax to small card points or rectangular cards. The use of points facilitates a good view of most of a specimen including the underside, but the specimen is less well protected from damage than if mounted on a card. Alternatively, while cards protect specimens from damage, care must be taken when mounting because nearly half of the insect is obscured from view. The use of either method is a matter of preference.

Extremely small specimens (e.g., Trichogrammatidae, Aphelinidae, Mymaridae) are usually mounted on slides for identification. Slide-making is a long, involved process that often approaches an art form (e.g., see Noyes 1982, 1990*b*). In the past it was the only useful method to mount and examine tiny, weak-bodied specimens that would shrink and distort as soon as they dehydrated. Once water leaves the body, the only way to recover a specimen's original shape is to soak it in chemicals and slide-mount it.

Now, however, there is a drying technique that allows small wasps to be handled more easily. Called critical point drying (see discussion by Gordh and Hall 1979), this method requires the use of equipment costing a few thousand dollars. The technique works only if the original specimens were collected directly into alcohol (i.e., they are not already shrivelled). Once dehydrated, specimens may be mounted as explained above. They also may be placed in gelatin capsules or microvials, pinned, labelled fully, and treated like individual specimens.

Hard bodied specimens collected in alcohol may be prepared for mounting by positioning upside down, with wings outstretched (i.e., not folded or crumpled), on a glass slide. It is most efficient to place the specimen momentarily in 95% alcohol before placing it on the slide. This creates rapid evaporation of the liquid, thus causing setae to stand away from the body and not be matted to it. Excess alcohol may be wicked away with tissue to speed drying. Specimens may also be placed on blotting paper or paper towelling, but this generally results in such rapid drying that the wings dry folded over on each other.

When a large quantity of alcohol-preserved, hard-bodied chalcidoids need to be dried, they may be placed in a shallow dish, covered with absolute alcohol, and placed in a self-defrosting freezer for several days. The resultant specimens appear the same as those that have undergone critical point drying. Small, weak-bodied specimens will display moderate shrivelling, so the technique is not entirely useful for them.

Labelling. All specimens should be fully and accurately labelled. Data obtained from specimens assures their value in scientific research which, in turn, assures that future work is repeatable. Essential data includes the country, lesser political unit (e.g., state, province, parish, county, etc.), exact locality, date, collector, host, and method of collection. This information should be as accurate and as complete as possible for each specimen. The more information that accompanies a specimen the more value will be its function to science. For instance, if a host is known it is also helpful to include information about the habitat or vegetation type in which the host was found and what specific plant (genus and species) it was associated with. If no host is known the plant from which the specimen was collected is still useful information. Even information about how the specimen was collected may provide clues to its role or place in the habitat. Researchers use all the data that they can obtain, not only for research but also to assist in identification. Therefore, accurately labelled specimens are essential.

Voucher Specimens. The need for voucher specimens was addressed by several authors (Yoshimoto 1978, Knutson 1984, Woolley 1991, Coulson et al. 1991, Coulson 1992), and our brief summary of this topic is taken from those treatments.

Voucher specimens serve as the physical link between research results and the organisms upon which the research was based. In many cases vouchers are the only means of subsequently verifying and confirming the identity of the species used in the study and the only way to assure that research is repeatable. Repeatability is important because systematics of the species involved may be unsettled and changes and improvement in the taxonomy is to be expected. Vouchers help trace the history and interpretation of species over time and it is especially important to have reliable vouchers in areas such as classical biological control where taxa are moved from one environment to another, often thousands of miles distant.

Vouchers associated with Nearctic field projects and published papers, if they are saved at all, are most often placed in established insect collections associated with governments or universities. When this happens it is better to incorporate voucher specimens into the main collection where they are readily available for research and revisionary work than to place them in a separate, special collection which eventually may be forgotten or misplaced. Recommendations have been made that a U.S. national voucher collection be established to serve as a repository for introduced beneficial arthropod specimens (Knutson 1984), and although such a collection is both needed and worthy of support, it has never been funded.

To serve as voucher specimens certain criteria must be met. At a minimum, these include:

1. CONDITION. Vouchers should be in good condition and properly preserved. Specimens must display the diagnostic features necessary for identification.
2. NUMBERS. Vouchers should be supplied in numbers adequate to allow for subsequent study, but not in such numbers that they place an undue burden on the researcher or the repository.
3. DATA. Vouchers must be adequately documented with all applicable data including full locality, date, collector, host, host plant, etc. They should be clearly labelled as vouchers and should reference the study they were associated with, including associated publications.
4. DEPOSITORY. Vouchers should be deposited in a permanent state/province, university, or federal collection and the depository should be cited in resulting publications.

Literature. A great deal of literature exists for the Chalcidoidea, which would be expected for a group of nearly 2,000 genera and 19,000 species. However, most of this literature is descriptive in nature and presupposes that one knows a great deal about the group. Thus, there is little in the way of entry-level literature that provides a means of identification to genus by those without experience in the group. In this section we review the most useful literature necessary for the study of Chalcidoidea. More detailed literature, useful at the family level and below, is discussed under the family sections later in this work.

In the New World, references listing the names, origin of descriptions, and host records of almost all the described species are available. Nearctic Chalcidoidea were cataloged extensively by Peck (1963), who gave complete bibliographic references to all species. This listing was updated in an abbreviated version in the 'Catalog of Hymenoptera in America North of Mexico' (Burks 1979, Gordh 1979, Grissell 1979). Unfortunately, some parts of the catalog were completed in the early 1970's and were outdated even before publication. This situtation was remedied, in part, by the checklist of Nearctic Hymenoptera names published by Poole (1996). In spite of this list, it is necessary to consult the literature from about 1972 to the present to have a complete bibliographic compilation for the Nearctic region.

The Neotropical species were nearly completely cataloged in a series of papers by L. De Santis. In 1967 he cataloged the species of Argentina, in 1980 the species of Brazil, and in 1979 species from other areas of the Neotropical region. De Santis published updated supplements to these catalogs in 1983, 1989, and 1994 (the latter with P. Fidalgo). Hanson and LaSalle (1995) provided a key to the 19 families of Chalcidoidea in Costa Rica and contributors provided keys to genera for nine of the families.

General references for the Nearctic region that provide means to identify chalcidoids at the family, and sometimes subfamily level, have been produced by several authors including Yoshimoto (1984), Borror et al. (1989), and Grissell and Schauff (1997).

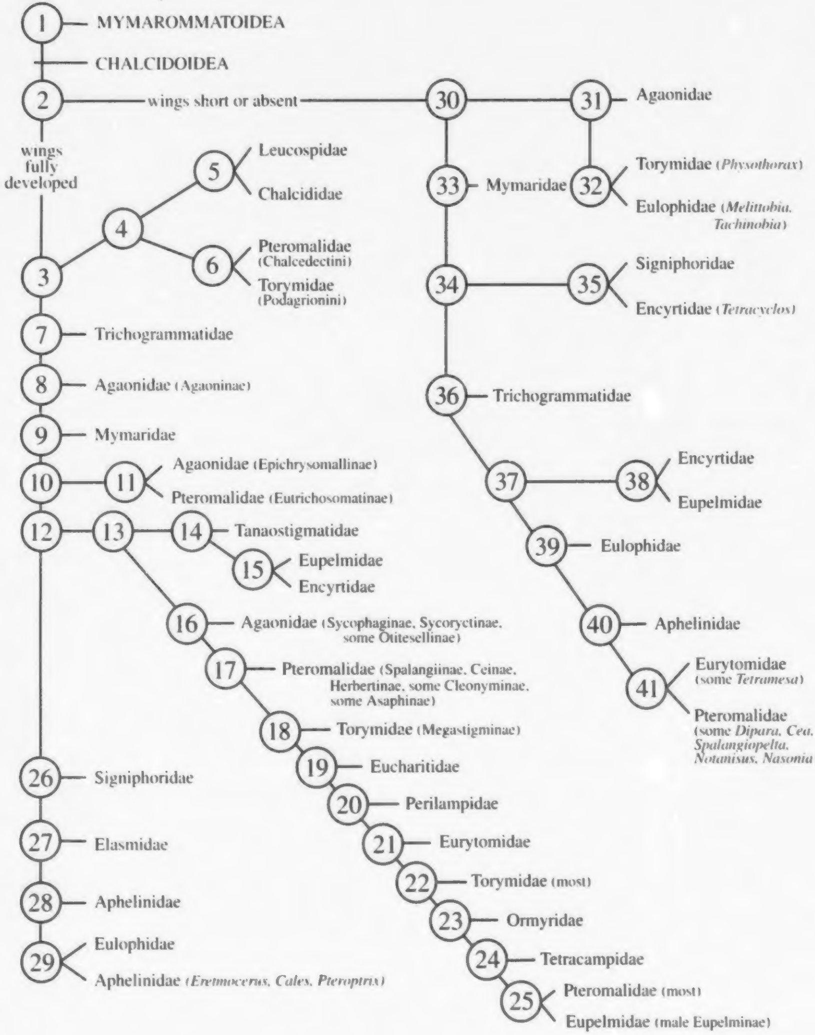
Important recent references to world Chalcidoidea include the following: Tryapitsyn (1978 — keys to genera and species of the European region of the former Soviet Union); Prinsloo (1980 — key and overview of families of sub-Saharan Africa); Subba Rao and Hayat (1985 — keys to families and genera of Indian chalcidoids) and (1986 — catalog of Indian chalcidoids) (see also Mani 1989); Noyes and Valentine (1989 — keys to numerically smaller families plus genera of New Zealand); Bouček (1988*a* — keys to genera of 14 families of Australasian chalcidoids and lists of over 2300 valid species); and Gibson (1993 — keys to families of the world).

Use of key to families. The family key developed for this work is primarily a combination of those by Grissell and Schauff (1997) and Gibson (1993). Those keys, in turn, are based upon the efforts of many previous workers who strove to make the recognition of Chalcidoidea easier for each succeeding generation. Each contributor to this volume has had an opportunity to review the family key and to make corrections or additions based upon information for groups that are the participant's specialty. In this manner a family key has evolved which should work in the great majority of instances for known Nearctic genera of Chalcidoidea. In some cases, problematic taxa are not keyed to the main family couplet but are placed in couplets of their own (e.g., male Eupelminae). In other cases, they may key to a family that is unexpected (e.g., some Agaonidae key to Pteromalidae), but in such cases provisions are made within the keys to genera to ensure correct family identification. The key is a practical one and does not pretend to reflect phylogenetic placement of taxa. We have attempted to be as precise and accurate as possible and yet make the key workable for specialist and nonspecialist alike. A flow chart (p. 64) is given to help the user understand the structure of the key and to give a visual impression of how the 19 families key out.

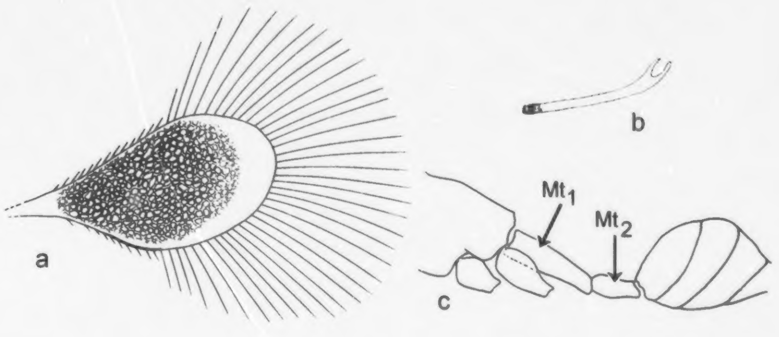
In the following key the figures associated with each alternate of a couplet are above it. Most figures are from Grissell and Schauff (1997), Gibson (1993), and other chapters in this publication. A few figures were reproduced (and altered somewhat) from external sources including Bouček (1977, 1988*a*, 1993), Bouček and Rasplus (1991), Dahms (1984), Prinsloo (1984), and Salt (1937). A number of additional drawings were made by Erik Denno specifically for this key.

Flow Chart for Family Key

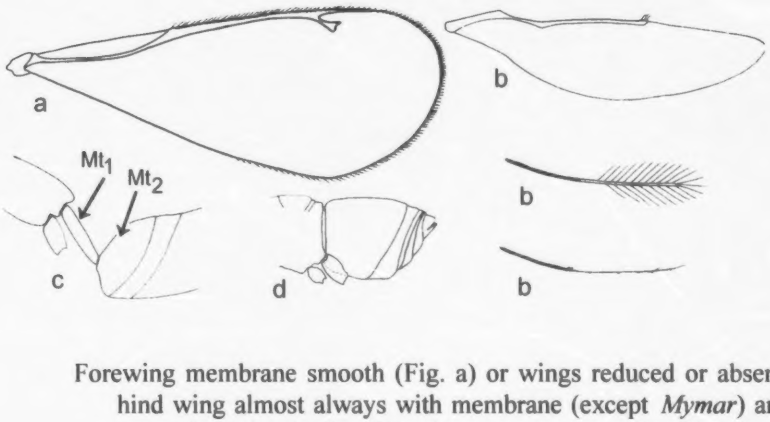
(Direction of flow is from lower to higher number)


1
MYMAROMMATOIDEA
CHALCIDOIDEA
2
wings short or absent
wings fully developed
3
4
5
Leucospidae
Chalcididae
6
Pteromalidae (Chalcedectini)
Torymidae (Podagrionini)
7
Trichogrammatidae
8
Agaonidae (Agaoninae)
9
Mymaridae
10
11
Agaonidae (Epichrysomallinae)
Pteromalidae (Eutrichosomatinae)
12
13
14
Tanaostigmatidae
15
Eupelmidae
Encyrtidae
16
Agaonidae (Sycophaginae, Sycoryctinae, some Otitesellinae)
17
Pteromalidae (Spalangiinae, Ceinae, Herbertinae, some Cleonyminae, some Asaphinae)
18
Torymidae (Megastigminae)
19
Eucharitidae
20
Perilampidae
21
Eurytomidae
22
Torymidae (most)
23
Ormyridae
24
Tetracampidae
25
Pteromalidae (most)
Eupelmidae (male Eupelminae)
26
Signiphoridae
27
Elasmidae
28
Aphelinidae
29
Eulophidae
Aphelinidae (*Eretmocerus, Cales, Pteroptrix*)
30
31
Agaonidae
32
Torymidae (*Physothorax*)
Eulophidae (*Melittobia, Tachinobia*)
33
Mymaridae
34
35
Signiphoridae
Encyrtidae (*Tetracyclos*)
36
Trichogrammatidae
37
38
Encyrtidae
Eupelmidae
39
Eulophidae
40
Aphelinidae
41
Eurytomidae (some *Tetramesa*)
Pteromalidae (some *Dipara, Cea, Spalangiopelta, Notanisus, Nasonia*)

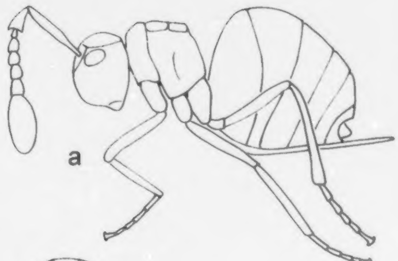
Key to families of Nearctic Chalcidoidea

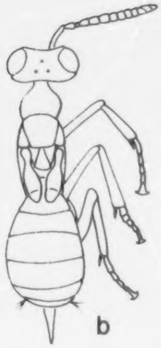


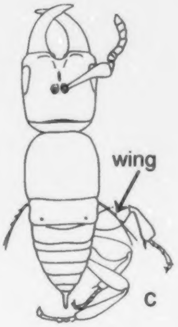
1 Forewing membrane reticulate (Fig. a); hind wing reduced to very short, apically forked vein (Fig. b); metasoma petiolate, with both Mt_1 and Mt_2 tubular (Fig. c); less than 1 mm long (extremely rare) .... MYMAROMMATOIDEA

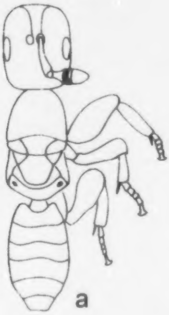


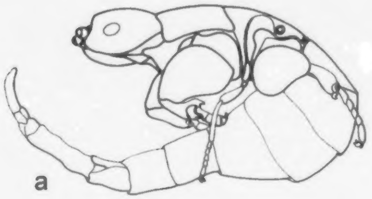
– Forewing membrane smooth (Fig. a) or wings reduced or absent; hind wing almost always with membrane (except *Mymar*) and never forked apically (Figs. b); metasoma sessile (Fig. d) or, if petiolate, then only Mt_1 tubular (Fig. c); body often longer than 1 mm .... CHALCIDOIDEA, 2



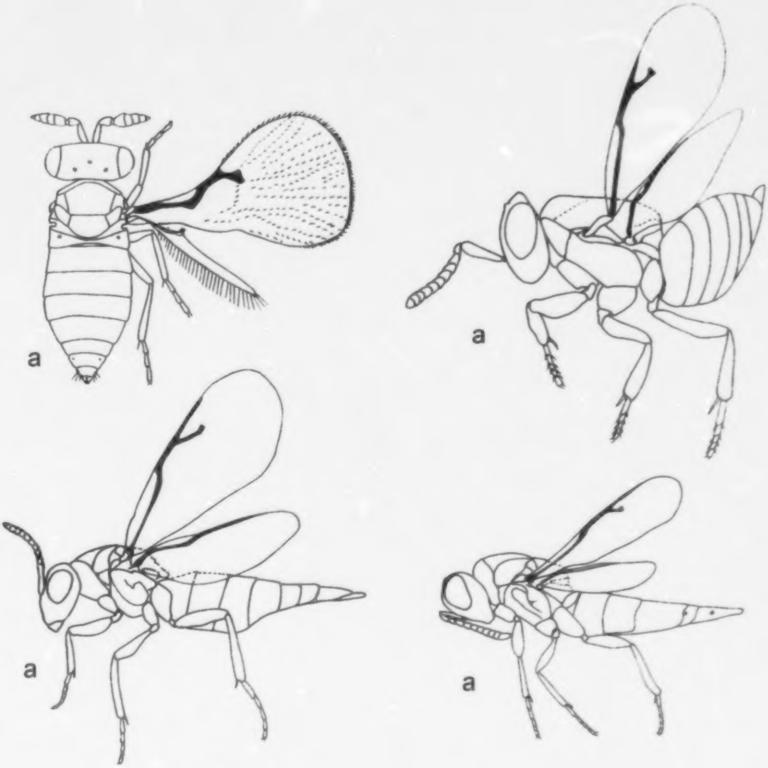




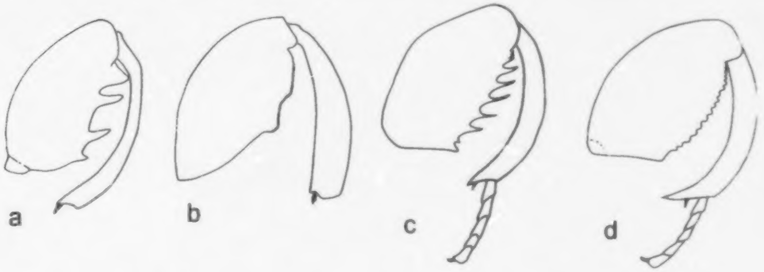




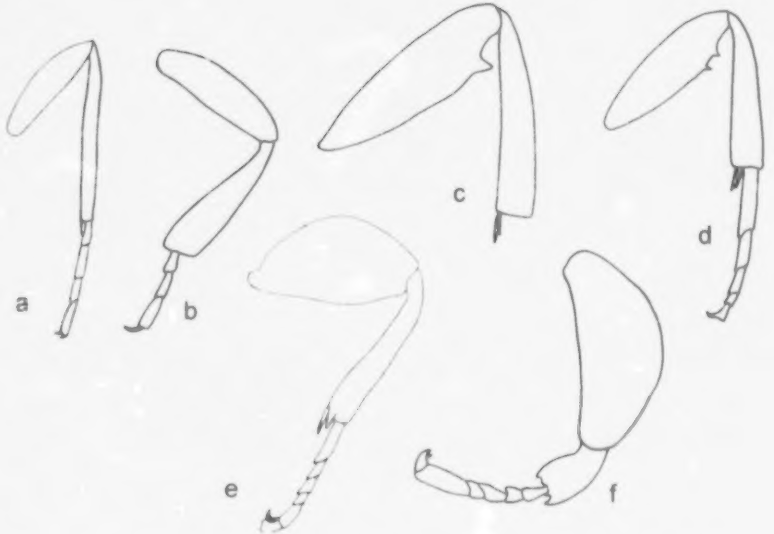
2(1) Wingless (Figs. a) or short winged (Fig. b), rarely forewing filament-like (Fig. c) (a few questionable taxa with short wings will run through either couplet) 30



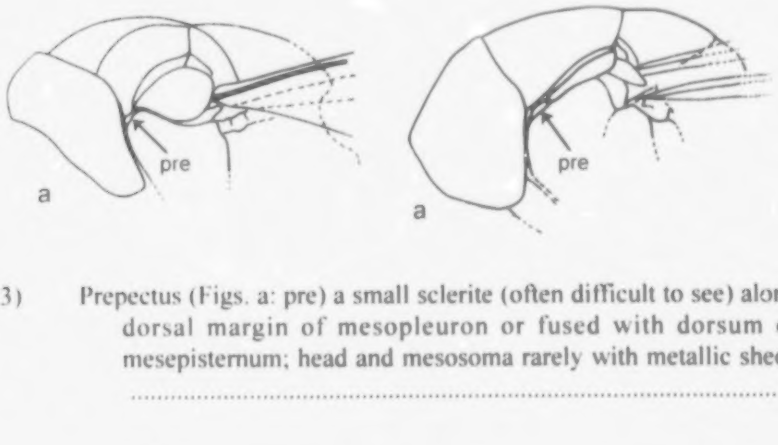
– Fully winged (Figs. a) 3



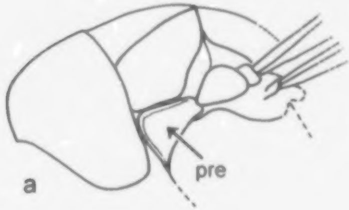
3(2) Metafemur enlarged and toothed (Figs. a, c) or serrate (Figs. b, d) along at least apical third of ventral margin, and subequal in length to metatibia; tarsi 5-segmented (Figs. c, d); body stout, generally 5–15 mm long 4

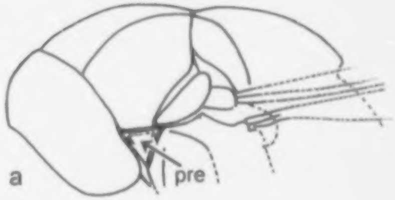


— Metafemur either not enlarged (Figs. a, b), normally much longer than wide, at most with 1 (Fig. c) or rarely 2 (Fig. d) subapical teeth, and subequal in length to metatibia (Figs. a–d) or, if metafemur somewhat enlarged (Figs. e, f), then without ventral teeth and sometimes much longer than metatibia (Fig. f); tarsi 3- (Fig. b), 4- (Fig. a), or 5-segmented (Figs. d, e, f); body stout to slender, generally 1–5 mm long 7

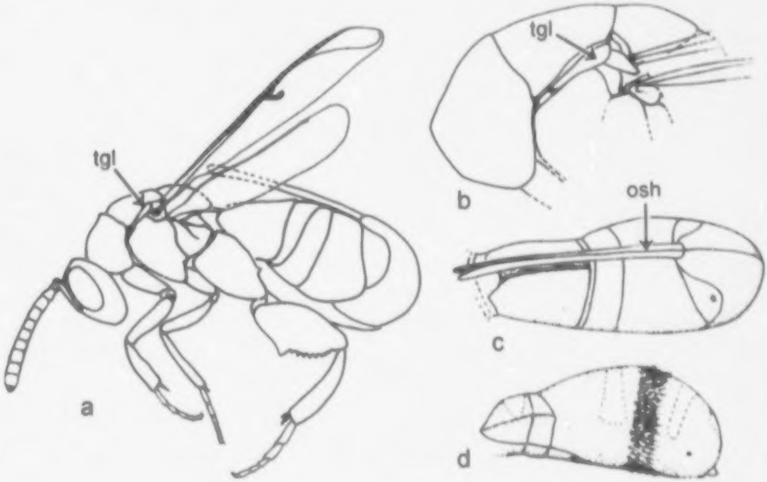


4(3) Prepectus (Figs. a: pre) a small sclerite (often difficult to see) along dorsal margin of mesopleuron or fused with dorsum of mesepisternum; head and mesosoma rarely with metallic sheen 5

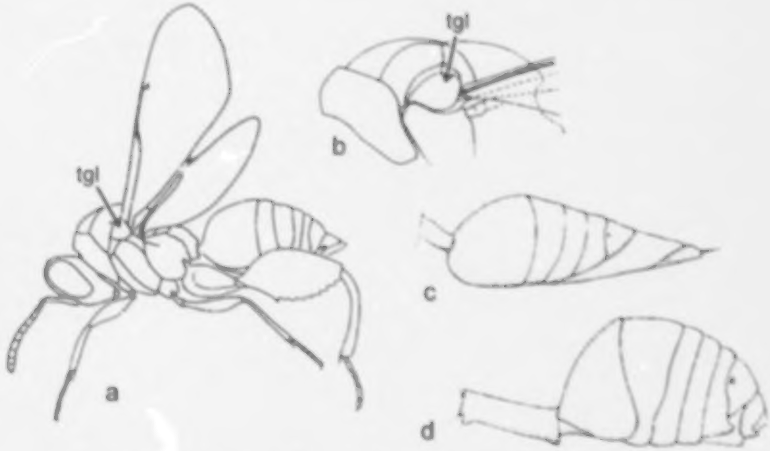




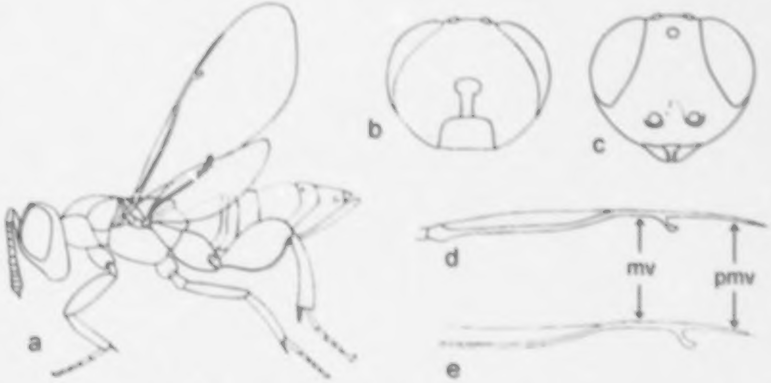
– Prepectus (Figs. a: pre) a distinct triangular sclerite; head and mesosoma usually with metallic sheen 6



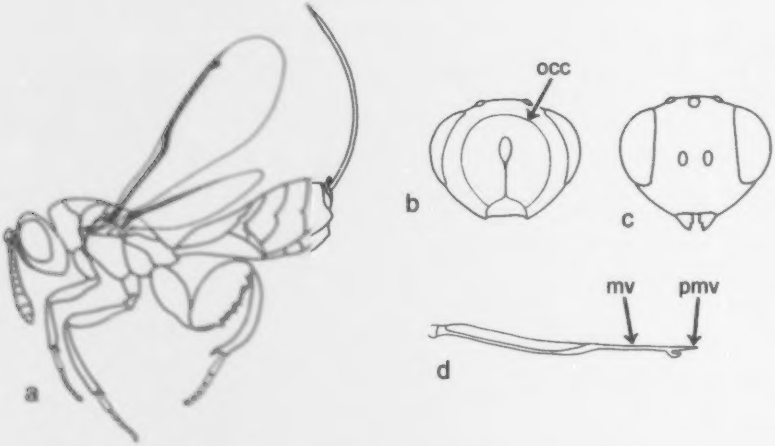
5(4) Tegula slender (Figs. a, b: tgl); metasoma with terga extensively and densely punctate, and petiole inconspicuous. *Female*: metasoma with 1 or more terga dorsally grooved longitudinally for reception of ovipositor sheaths (if long the sheaths are curved forward) (Figs. a, c: osh). *Male*: metasoma with most terga fused into carapace (Fig. d) .... **LEUCOSPIDAE** (p. 496)



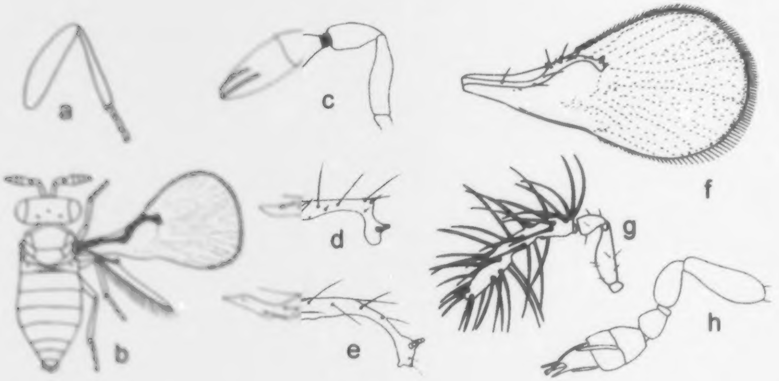
– Tegula broader, nearly oval (Figs. a, b: tgl); metasoma with terga at most sparsely punctate, and petiole inconspicuous (Fig. a) to greatly elongate (Figs. c, d). *Female*: metasoma with terga dorsally not grooved longitudinally, and ovipositor sheaths directed horizontally (the sheaths sometimes projecting beyond apex of metasoma). *Male*: metasoma with terga not fused (Fig. d) .... **CHALCIDIDAE** (p. 151)



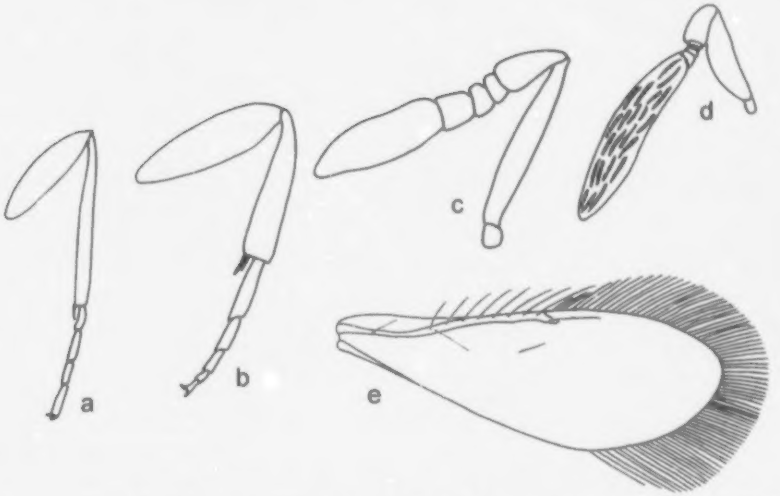
6(4) Forewing with marginal vein less than (Fig. e) to at most 1.5 times as long as postmarginal vein (Figs. a, d); head without occipital carina (Fig. b); eyes in anterior view with inner margins usually diverging at least in lower half (Fig. c) .... **PTEROMALIDAE** (Chalcedectini) (p. 541)



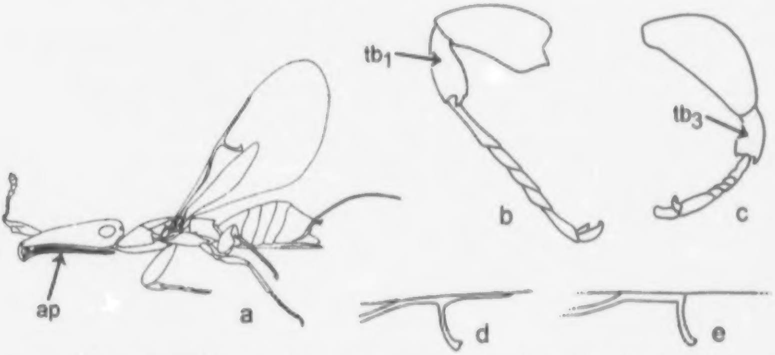
– Forewing with marginal vein at least 3 times as long as postmarginal vein (Figs. a, d); head with occipital carina (Fig. b: occ); eyes in anterior view with inner margins subparallel (Fig. c) .... **TORYMIDAE** (Podagrionini) (p. 709)



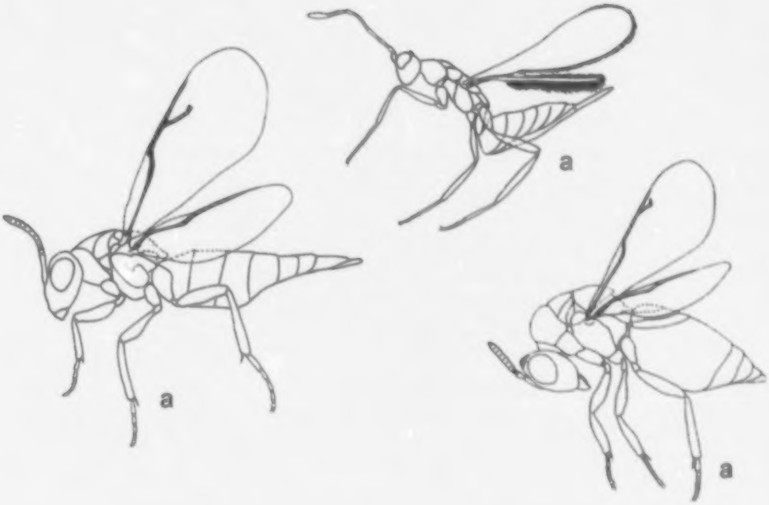
7(3) Tarsi 3-segmented (Figs. a, b); body small to minute, less than 1.0 mm long, with antennae short (Fig. b), usually without obvious funicle (Figs. c, g) but rarely with 1 or 2 funicular segments (Fig. h), and forewing setose, often with obvious vein tracts (Figs. b, f), and reduced venation without postmarginal vein (Figs. d, e) .... **TRICHOGRAMMATIDAE** (p. 726)



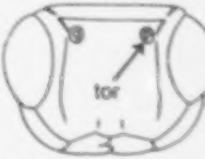
– Tarsi 4- or 5-segmented (Figs. a, b); body generally larger, more than 1 mm long but, if small, then different from above, with antenna usually longer or with at least 3 funicular segments (Fig. c), or wing membrane without setae (Fig. e) and clava elongate and unsegmented (Fig. d); wing veins variable 8



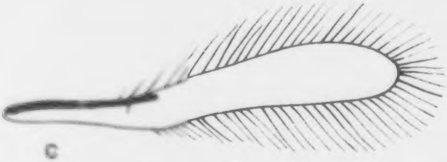
8(7) *Female only* [male wingless, see couplet 31]: mandible with ventral rasp-like appendage (Fig. a: ap); head dorsoventrally flattened and projecting forward (prognathous); protibia (Fig. b: tb_1) and sometimes metatibia (Fig. c: tb_3) shorter than respective femur, both tibiae apically with stout spine(s); forewing with stigmal vein arising at right angle from marginal vein (Figs. d, e) and often without postmarginal vein (Fig. e); associated with figs (*Ficus*) .... **AGAONIDAE** (AGAONINAE) (p. 117)



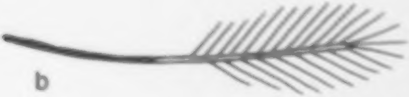
– *Both sexes*: mandible without rasp-like appendage (Figs. a); head variable, usually projecting downward (Figs. a); tibiae subequal in length to respective femur, apically without stout spines; forewing with venation variable; host association variable, including *Ficus* 9



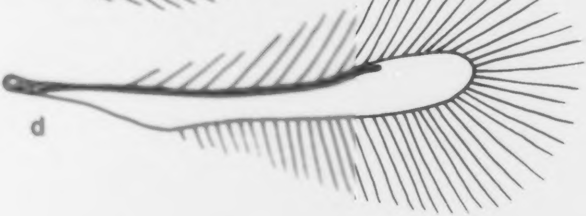
a



c

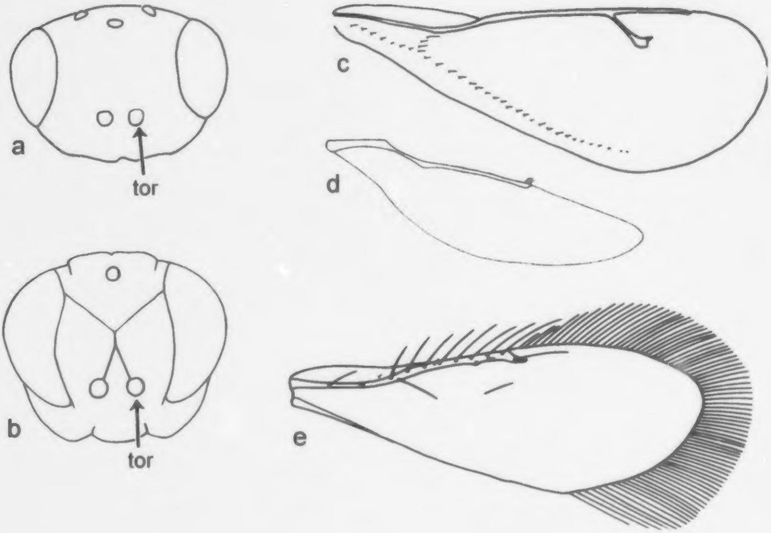


b

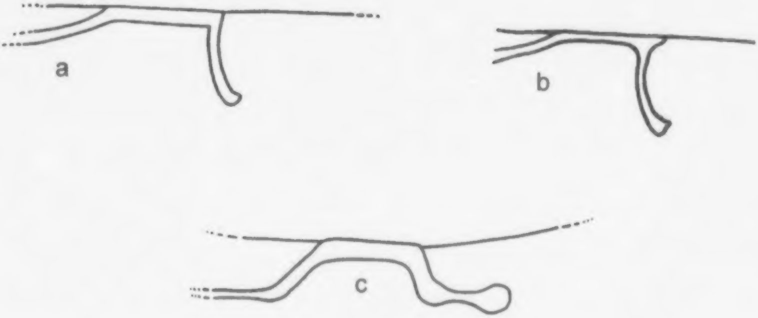


d

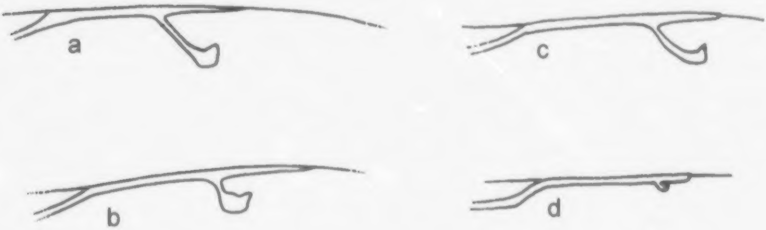
9(8) Head with dark, H-shaped lines on vertex and face (transverse line above toruli usually conspicuous, other lines sometimes difficult to see), and with toruli (Fig. a: tor) closer to eye margins than to each other, often almost touching eye margins; hind wing stalked basally, with membranous part very narrow (Fig. b); forewing with venation ending in basal third [except *Arescon* (Fig. d) and *Krokella*], apparently without postmarginal vein and with stigmal vein rudimentary (Fig. c); forewing and hind wing usually with long marginal setae (Figs. b–d); body almost always less than 2 mm long .... **MYMARIDAE** (p. 499)



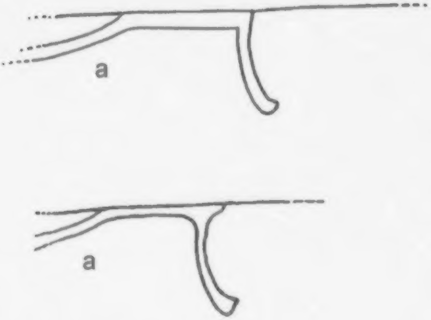
– Head without dark, H-shaped lines on vertex and face (Figs. a, b), and with distance between toruli usually about equal to distance from torulus to eye margin, sometimes less; hind wing with membrane extending to base, the membranous part much broader (Fig. d); forewing with venation ending beyond basal third (Figs. c, e), and postmarginal and stigmal veins usually apparent (Fig. c); forewing and hind wing usually with short marginal setae [if setae long (Signiphoridae), then membrane largely without setae (Fig. e)]; body variable, but generally over 2 mm long 10

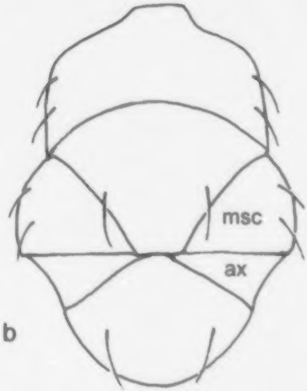


10(9) Forewing with stigmal vein arising at almost right angle from marginal vein (Figs. a–c), **and** the stigma plus stigmal vein at least as long as marginal vein, **and** postmarginal vein reduced to stub (Fig. b) or absent (Figs. a, c) 11

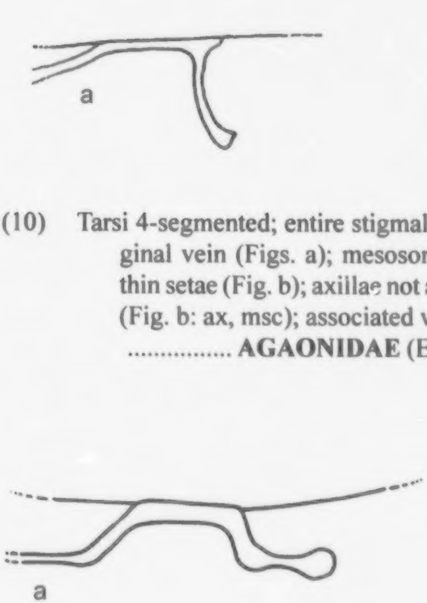


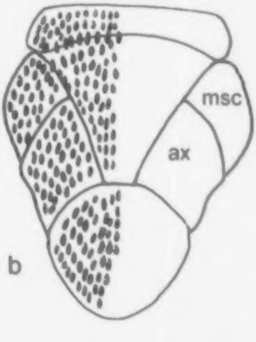
– Forewing with stigmal vein arising at obtuse angle from marginal vein (Figs. a, c) **or**, if at nearly right angle, stigma plus stigmal vein much shorter than marginal vein (Figs. b, d), and postmarginal variable 12



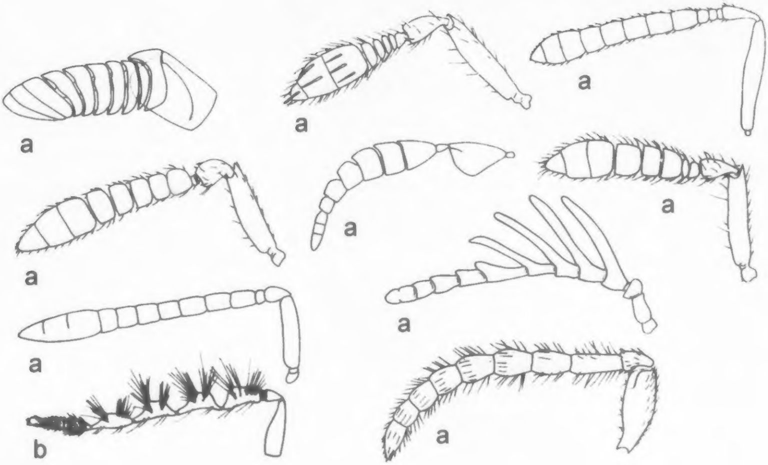


11(10) Tarsi 4-segmented; entire stigmal vein almost perpendicular to marginal vein (Figs. a); mesosoma smooth, with few suberect and thin setae (Fig. b); axillae not advanced forward into mesoscutum (Fig. b: ax, msc); associated with *Ficus* .... **AGAONIDAE** (EPICHRYSOMALLINAE) (p. 117)

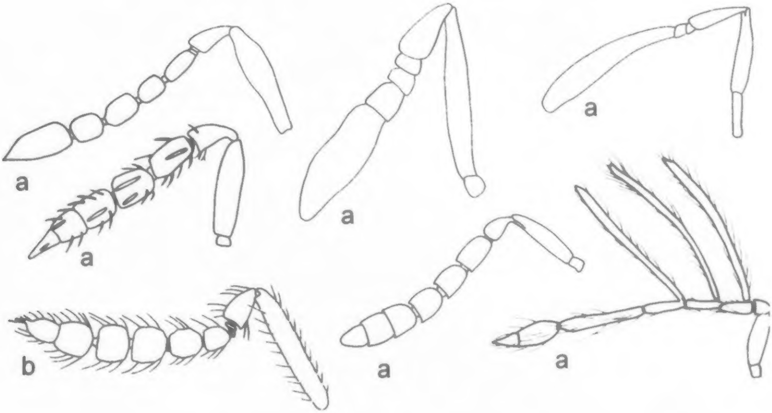




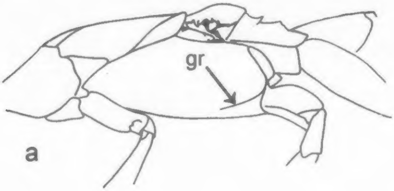
– Tarsi 5-segmented; stigmal vein in part bent parallel to marginal vein (Fig. a); mesosoma with distinct sculpture and appressed, scale-like setae (Fig. b); axillae advanced far forward into mesoscutum (Fig. b: ax, msc); associated with Coleoptera in southwestern USA, and Mexico .... **PTEROMALIDAE** (EUTRICHOSOMATINAE) (p. 541)

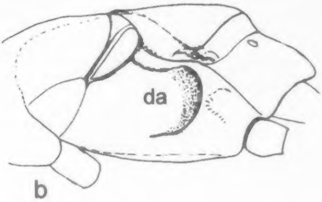


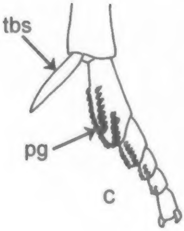
12(10) Flagellum with 8–11 clearly visible segments (minimum of 100 X magnification) (Figs. a) or, if questionably 7-segmented (Fig. b), tarsi 5-segmented; usually hard-bodied specimens longer than 3 mm 13

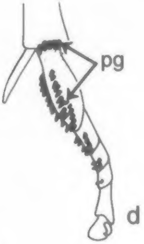


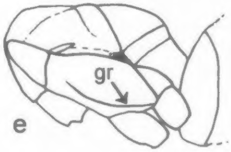
– Flagellum with 3–6 clearly visible segments (Figs. a) or, if questionably 7-segmented (Fig. b), then tarsi 4-segmented; usually soft-bodied specimens shorter than 3 mm 26



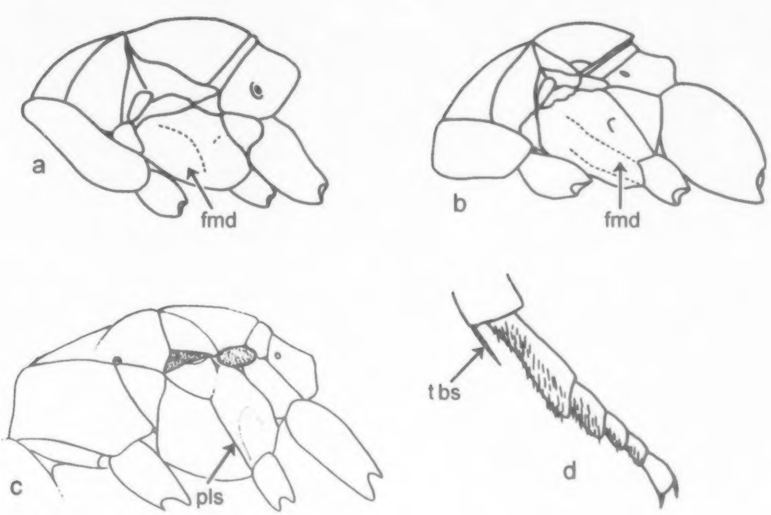




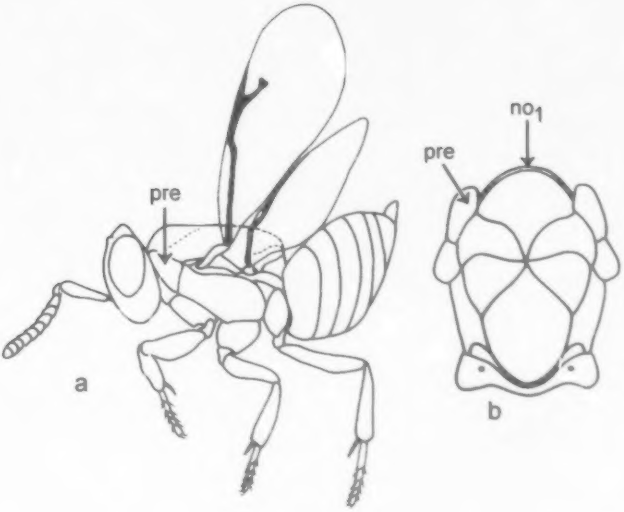




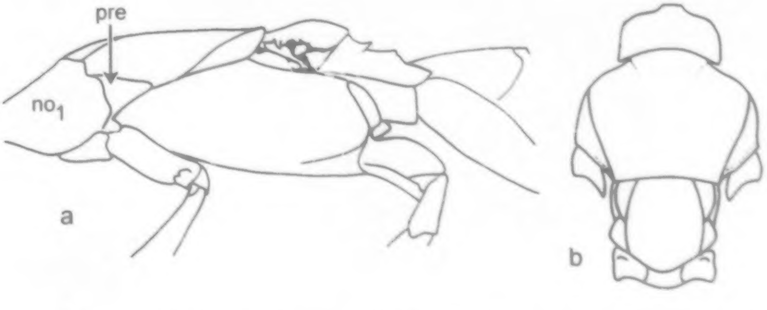
13(12) Mesopleuron almost always longer than high, convex (Figs. a, e), and usually with ventral longitudinal furrow or groove (Figs. a, e: gr) extending from mesocoxa toward prepectus, but very rarely (*Archaeopelma*) mesopleuron with vertical, posteriorly curved sulcus distinguishing slightly depressed area (Fig. b: da) covering at least anterior half of pleuron; mesotibia with relatively thick apical spur (Figs. c, d: tbs) and often with pegs along inner apical margin (Fig. d: pg); mesotarsus ventrally often with 1 or more rows of thick pegs, at least on basitarsus (Figs. c, d: pg) 14



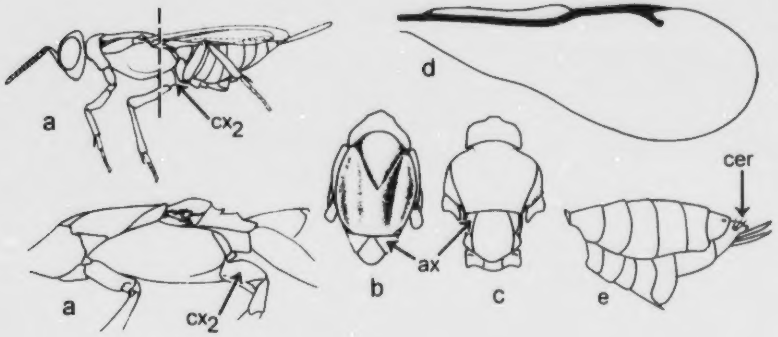
– Mesopleuron subquadrate or higher than long (Figs. a–c), usually with oblique to vertical femoral depression (Figs. a, b: fmd), rarely with groove or finely impressed line (Fig. c: pls) extending from mesocoxa toward base of forewing; mesotibia usually with thin apical spur (Fig. d: tbs) and at most with bristles along inner apical margin; mesotarsus at most with bristles (Fig. d) 16



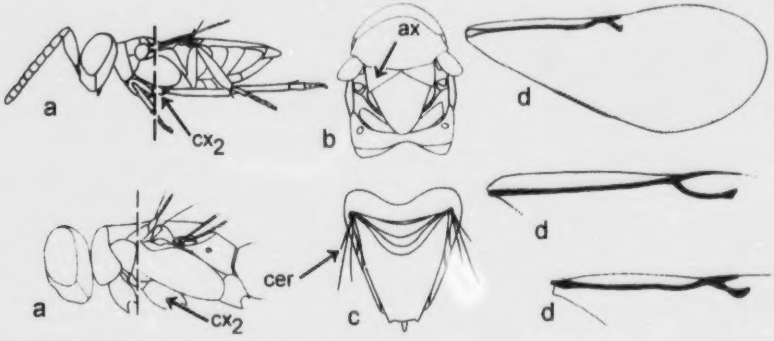
14(13) Prepectus (Figs. a, b: pre) in dorsal view bulbous and protruding anteriorly beside pronotum (Fig. b: no$_1$) .... **TANAOSTIGMATIDAE** (p. 700)



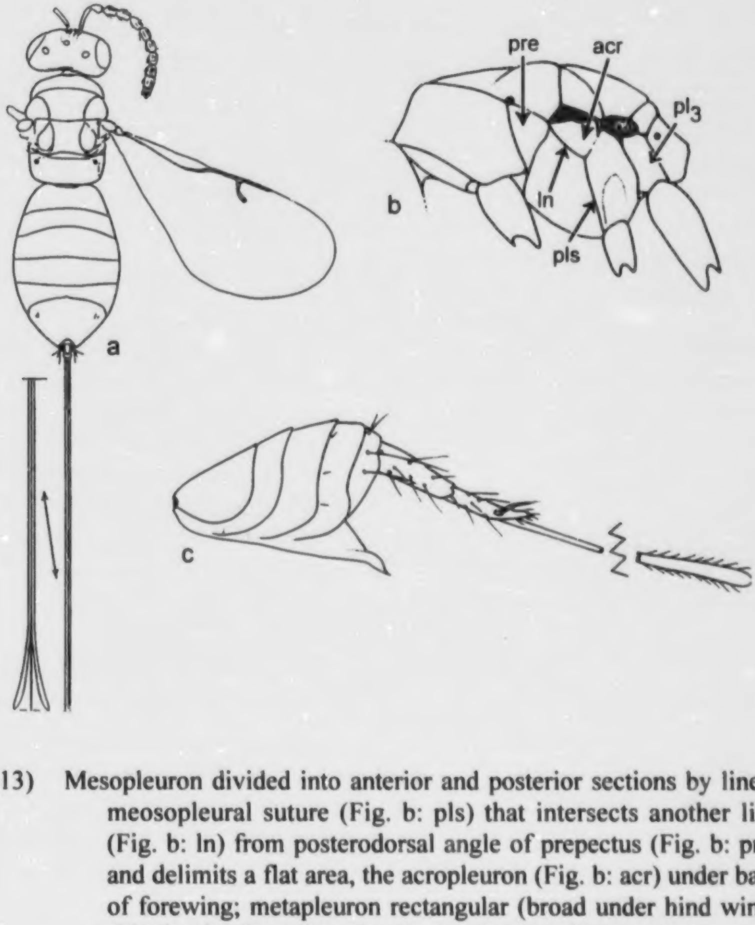
– Prepectus in dorsal view not visible (Fig. b), a flat sclerite (Fig. a: pre) posterior to pronotum (Fig. a: no$_1$) 15



15(14) Mesocoxa (Figs. a: cx$_2$) inserted posterior to midline of mesopleuron, much closer to metacoxa than to procoxa; axillae equilaterally (Fig. b: ax) or longitudinally (Fig. c: ax) triangular, sometimes not meeting medially (Fig. c); metasoma with most terga band-like and with cercus at apex (Fig. e: cer); marginal vein relatively long compared to stigmal vein and postmarginal vein (Fig. d) ... . **EUPELMIDAE** (p. 430)

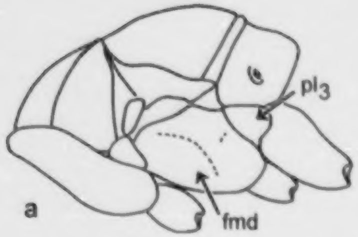


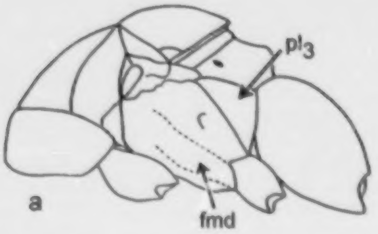
– Mesocoxa (Figs. a: cx$_2$) inserted anterior to midline of mesopleuron, much closer to procoxa than to metacoxa; axillae acutely transverse-triangular (Fig. b: ax), meeting medially; metasoma with apical terga V-like and cerci advanced anteriorly (Fig. c: cer); marginal vein relatively short compared to stigmal vein and postmarginal vein (Figs. d) and often only about as long as wide .... **ENCYRTIDAE** (p. 170)



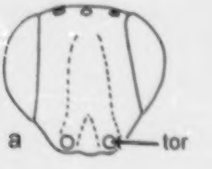
16(13) Mesopleuron divided into anterior and posterior sections by linear meosopleural suture (Fig. b: pls) that intersects another line (Fig. b: ln) from posterodorsal angle of prepectus (Fig. b: pre) and delimits a flat area, the acropleuron (Fig. b: acr) under base of forewing; metapleuron rectangular (broad under hind wing) (Fig. b: pl_3). *Female*: ovipositor projecting (Figs. a, c) .... **AGAONIDAE** (p. 117)

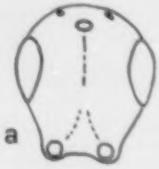
(SYCOPHAGINAE, SYCORYCTINAE,
some OTITESELLINAE)



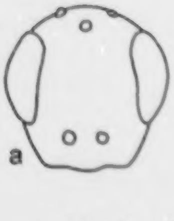


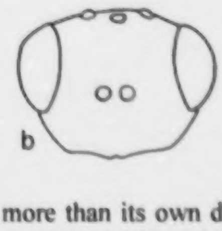
– Mesopleuron depressed but not completely divided in half, with partial, oblique depression extending from near base of forewing to near base of mesocoxa (Figs. a: fmd); small area under base of forewing usually only vaguely defined, often bulging; metapleuron variable but most often acutely angled under hind wing (Figs. a: pl_3); ovipositor variable 17

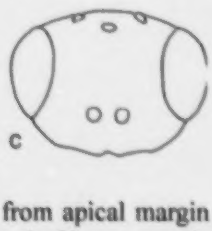




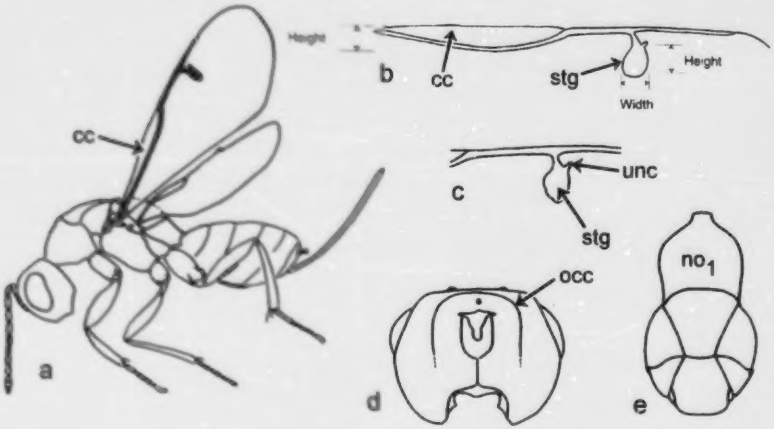
17(16) Torulus at most its own diameter from apical margin of clypeus (Figs. a: tor) and obviously at or below level of lower margin of eye (if undecided, then run specimens here) ....
.... **PTEROMALIDAE** (p. 541)
(SPALANGIINAE, CEINAE, HERBERTINAE, some CLEONYMINAE and ASAPHINAE)



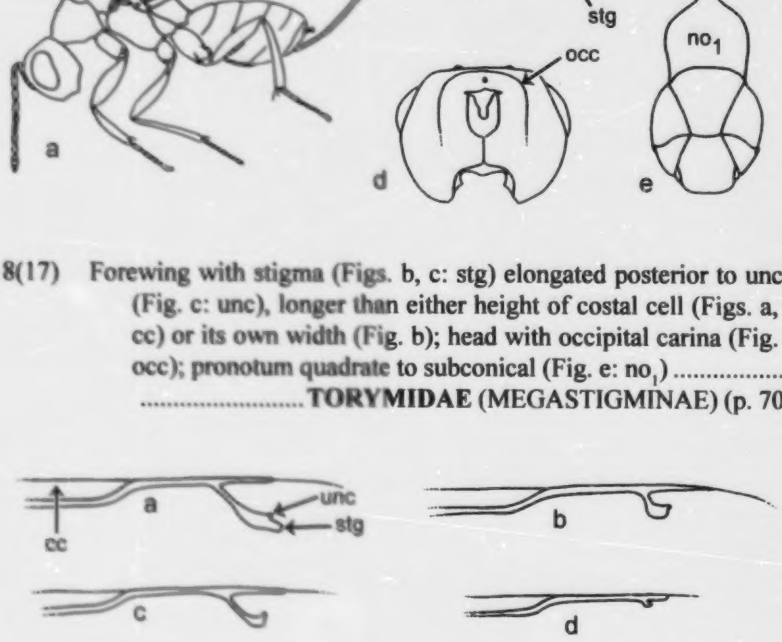




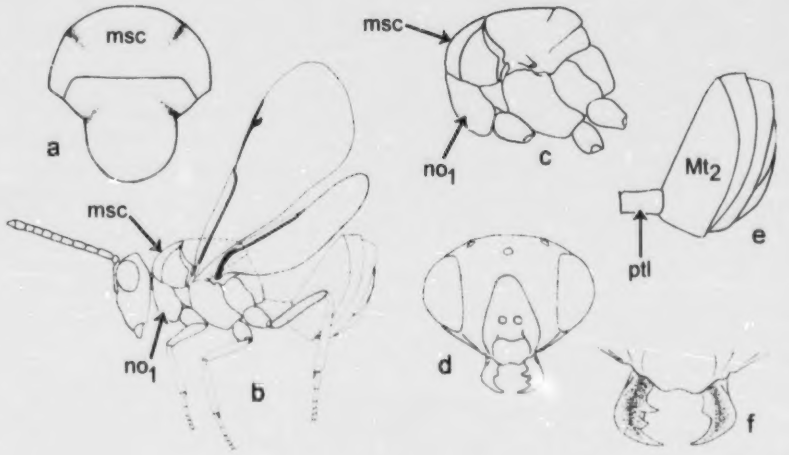
– Torulus clearly more than its own diameter from apical margin of clypeus (Figs. a–c), variable relative to level of lower margin of eye, but only rarely distinctly below eye (Fig. a) 18



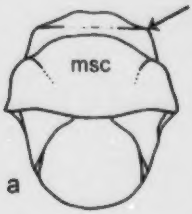
18(17) Forewing with stigma (Figs. b, c: stg) elongated posterior to uncus (Fig. c: unc), longer than either height of costal cell (Figs. a, b: cc) or its own width (Fig. b); head with occipital carina (Fig. d: occ); pronotum quadrate to subconical (Fig. e: no$_1$) .... **TORYMIDAE** (MEGASTIGMINAE) (p. 709)

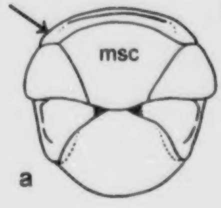


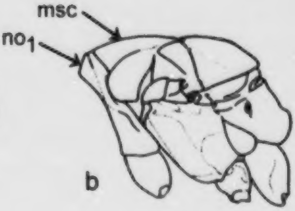
– Forewing with stigma (Fig. a: stg) short posterior to uncus (Fig. a: unc), shorter than either height of costal cell (Fig. a: cc) or its own width, the stigma usually quadrate (Figs. b, c), sometimes reduced (Fig. d) or much wider than long (Fig. a) (i.e., extended laterally not posteriorly); head with or without occipital carina; pronotum variable, usually transverse 19

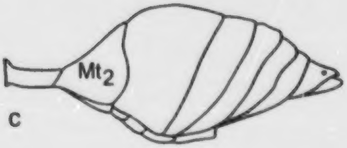


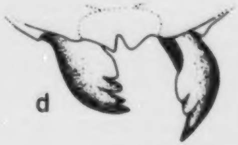
19(18) Pronotum in dorsal view not visible (Fig. a); mesoscutum (Figs. b, c: msc) in lateral view abruptly convex anteriorly and overhanging pronotum (Figs. b, c: no$_1$); metasoma with Mt$_1$ forming distinct petiole (Fig. e: ptl) and Mt$_2$ (Fig. e: Mt$_2$) at least as long as remaining terga; mandible with teeth oriented in vertical plane, the apical teeth long (Figs. d, f) or, rarely, mandible peg-like .... **EUCHARITIDAE** (p. 321)



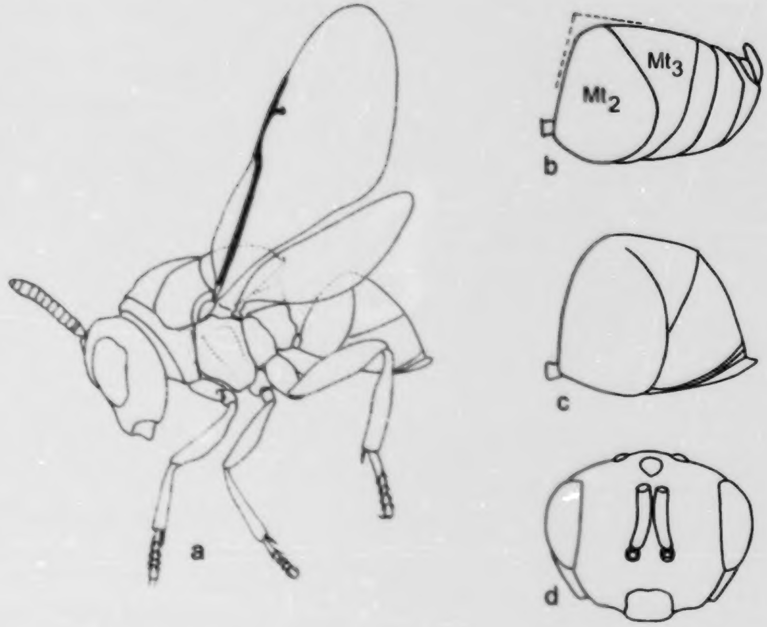




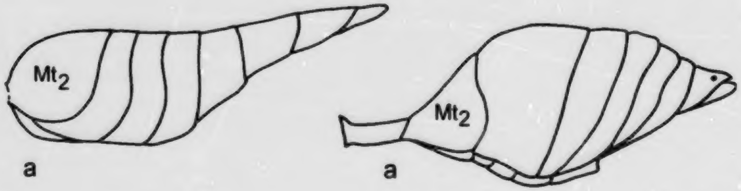




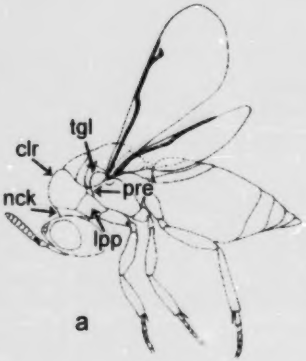
– Pronotum in dorsal view almost always visible (Figs. a: no_1); mesoscutum in lateral view not abruptly convex above pronotum (Fig. b: msc); metasoma with Mt_1 usually transverse and often difficult to see, but if forming petiole then Mt_2 (Fig. c: Mt_2) almost always shorter than remaining terga, rarely subequal or covering remaining terga; mandible with teeth variable, usually oriented in horizontal or oblique plane and subequal in size (Fig. d) 20

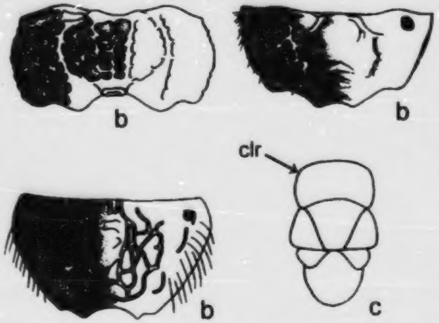


20(19) Metasoma in lateral view with dorsum of Mt$_2$ at nearly right angle to Mt$_3$ (Figs. a–c); Mt$_2$ and Mt$_3$ fused dorsally, usually without suture (Fig. c), but if suture present dorsally between them (Fig. b) then either pronotum with submedian raised tubercles or Mt$_3$ covering remainder of terga; clypeus separated from face by sutures (Fig. d); body often squat (Fig. a) ....
.... **PERILAMPIDAE** (p. 534)

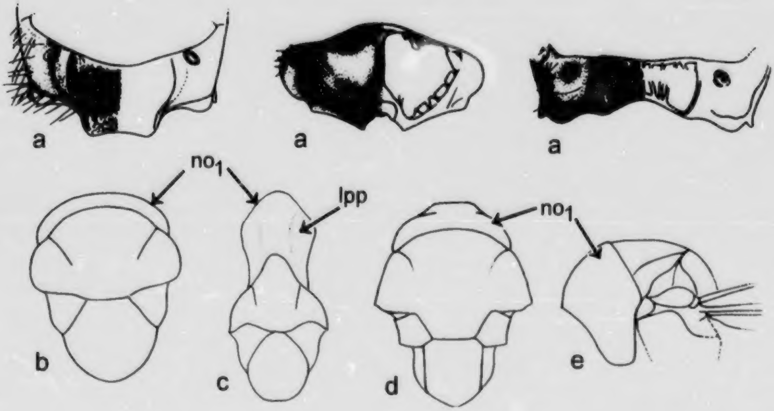


– Metasoma in lateral view with dorsum of Mt_2 and Mt_3 in about same plane (Figs. a); clypeus variable, usually poorly differentiated from face; body variable, but usually elongate 21

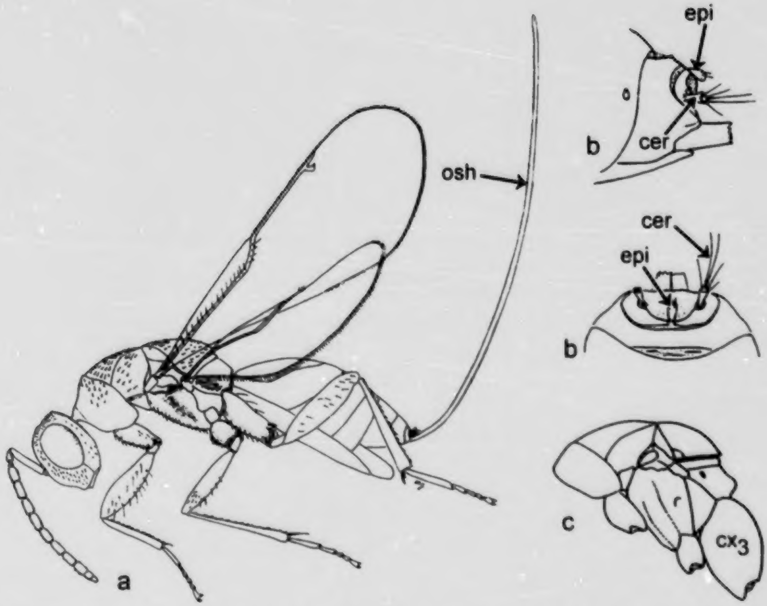




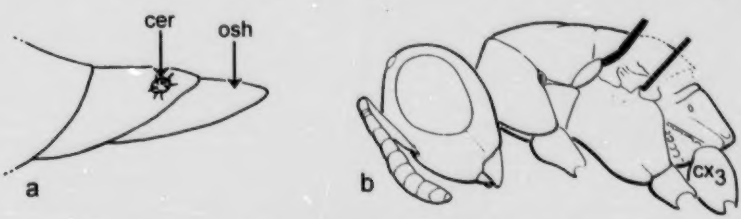
21(20) Pronotum in dorsal view with rectangular or quadrate collar (Figs. c: clr) at least half as long as mesoscutum, with lateral panel flat (Fig. a: lpp), and with neck (Fig. a: nck) in lateral view often nearly at right angle to dorsum of collar; **either** propodeum broadly depressed medially, often with median channel laterally delimited by carinae and propodeum partially to entirely carinate (laterally with piliferous punctures and/or irregular carinae) (Figs. b) **or** prepectus much reduced relative to tegula (Fig. a: pre, tgl); body usually black (rarely with faint metallic sheen), but sometimes yellow or brown .... **EURYTOMIDAE** (p. 477)



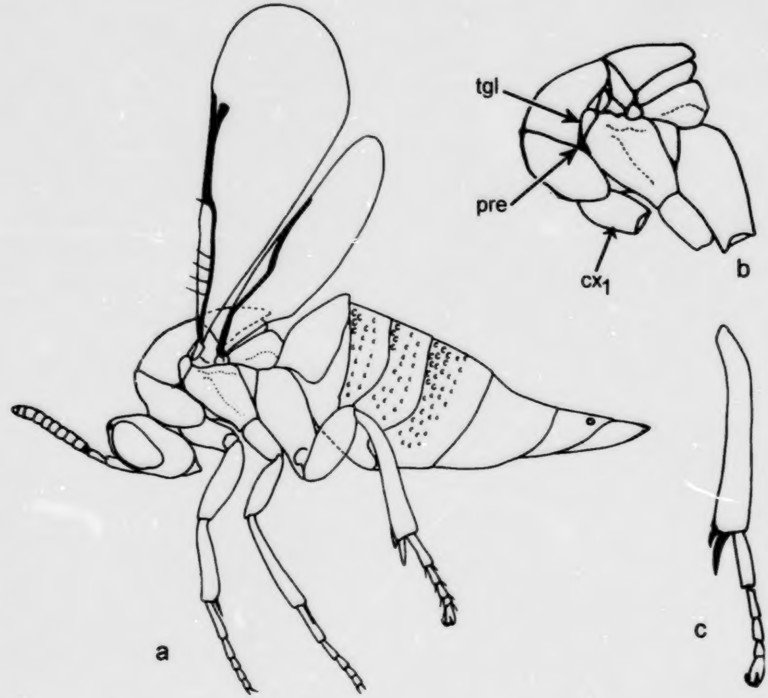
– Pronotum usually transverse (Figs. b, d: no$_1$), rarely elongate, but then lateral panel depressed (Fig. c: lpp) or, if pronotum appearing quadrate in dorsal view, then in lateral view sloping from posterior of pronotum to back of head (i.e., without collar at right angle to neck) (Fig. e: no$_1$); propodeum highly variable, medially flat or convex, but seldom with median channel or irregular carina (surface may be covered by sculpture of various types, but without distinct carinae) (Figs. a); prepectus rarely reduced; body usually with metallic sheen, rarely yellow or brown 22



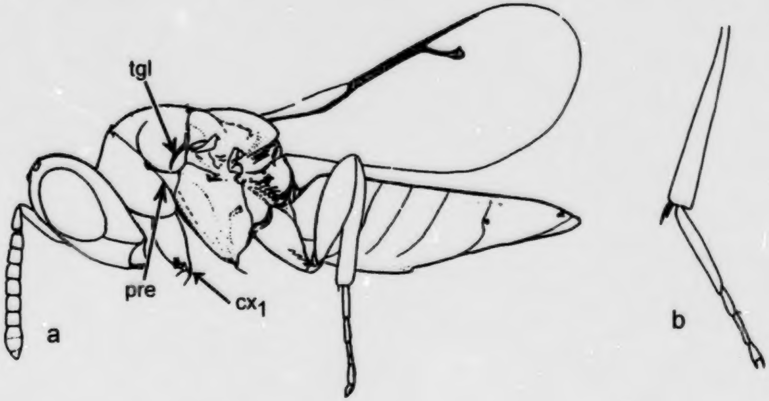
22(21) Mt_8 with elongate cercus (Figs. b: cer); metacoxa (Fig. c: cx_3) often 1.5 times or more length of procoxa (Figs. a, c), but if metacoxa and procoxa subequal in length then notauli usually indistinct; head usually with occipital carina. *Female*: apex of metasoma with flap-like epipygium (Figs. b: epi); ovipositor sheaths (Fig. a: osh) usually greatly projecting beyond apex of metasoma .... most **TORYMIDAE** (p. 709)



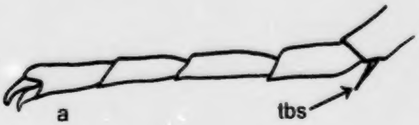
– Mt_8 almost always with bump-like cercus (Fig. a: cer) (except for a few Pteromalidae); metacoxa (Fig. b: cx_3) usually subequal in length to procoxa, but if enlarged then notauli usually distinct; head usually without occipital carina. *Female*: apex of metasoma without epipygium; ovipositor sheaths usually barely projecting beyond apex of metasoma (Fig. a: osh) 23



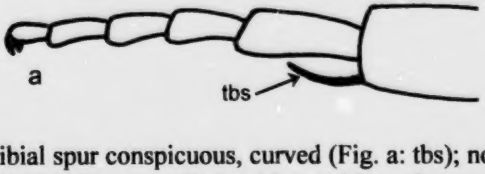
23(22) Metasoma with transverse band of coarse punctures (Fig. a) or crenulae on one or more terga; metatibia with thick, somewhat widely spaced apical spurs (Fig. c); prepectus (Fig. b: pre) smaller than tegula (Fig. b: tgl) and distinctly separated from procoxa (Fig. b: cx$_1$) .... **ORMYRIDAE** (p. 531)



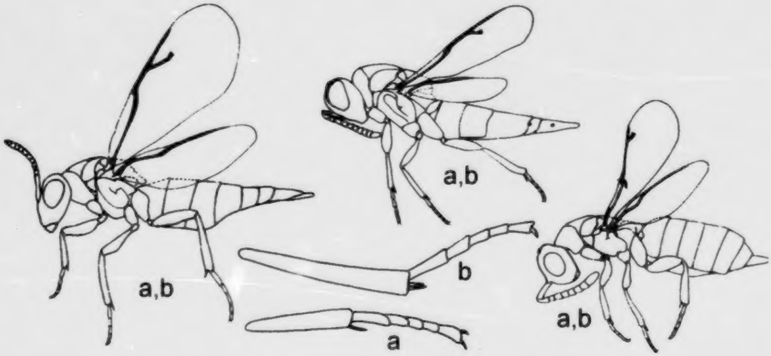
– Metasoma without transverse bands of coarse punctures, either smooth or uniformly sculptured overall (Fig. a); metatibia with slender, closely spaced apical spurs (Fig. b); prepectus (Fig. a: pre) usually subequal to tegula (Fig. a: tgl) and usually adjacent to procoxa (Fig. a: cx_1) 24



24(23) Protibial spur relatively inconspicuous, straight (Fig. a: tbs); notauli complete; scutellum with frenum. *Male*: tarsi sometimes 4-segmented; very rarely collected .... **TETRACAMPIDAE** (p. 705)

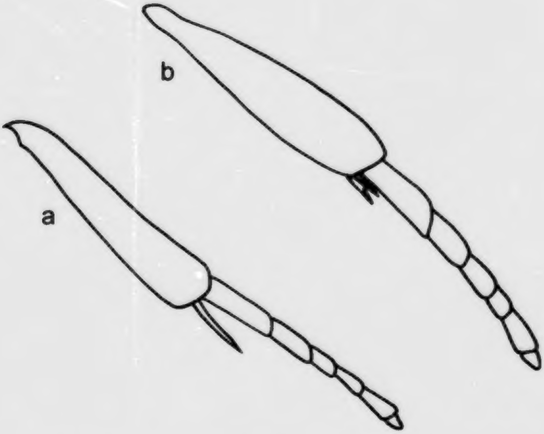


– Protibial spur conspicuous, curved (Fig. a: tbs); notauli complete or incomplete; scutellum with or without frenum. *Both sexes*: tarsi almost always 5-segmented (mesotarsus 4-segmented in females of *Macromesus*); very commonly collected 25

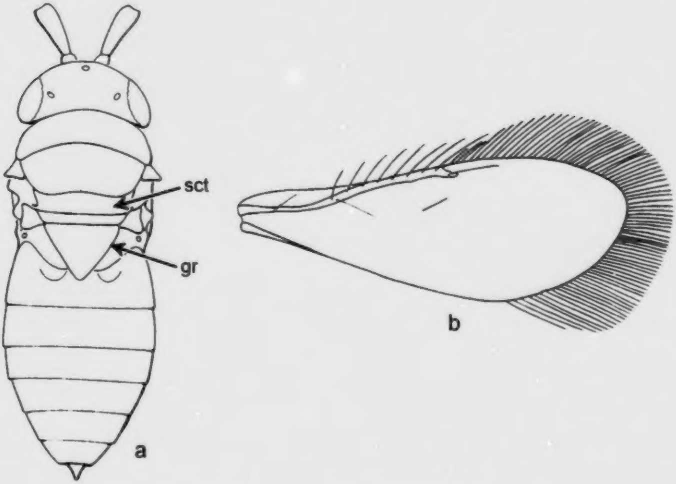


25(24) *Both sexes*: mesotibial spur (Fig. a) usually slender and subequal in length to metatibial spurs (Fig. b); metatibial spur may be longer than width of metatibial apex .... most **PTEROMALIDAE** (p. 541)

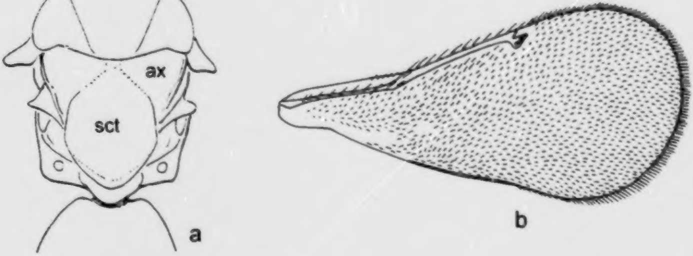
Note: some Agaonidae key here but will run through the key to genera of Pteromalidae.



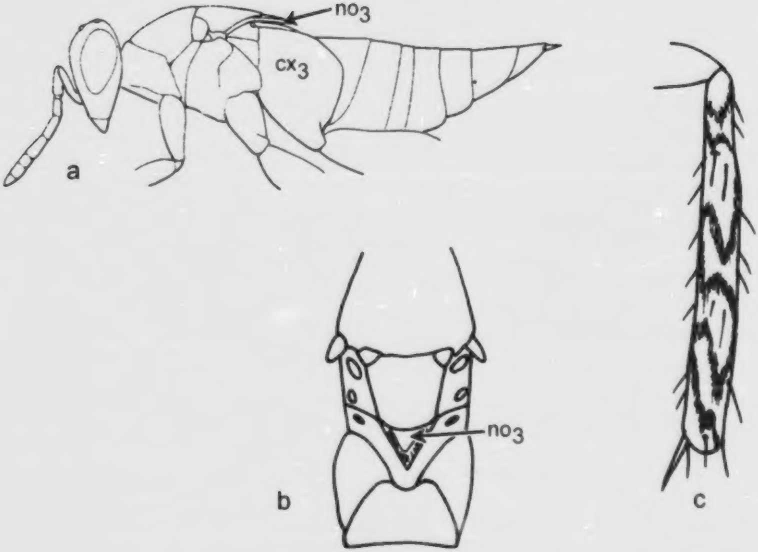
– *Male only*: mesotibial spur (Fig. a) long and slightly thickened relative to slender, short metatibial spurs; metatibial spurs (Fig. b) shorter than width of metatibial apex or at least conspicuously shorter than mesotibial spur .... **EUPELMIDAE** (male EUPELMINAE) (p. 430)



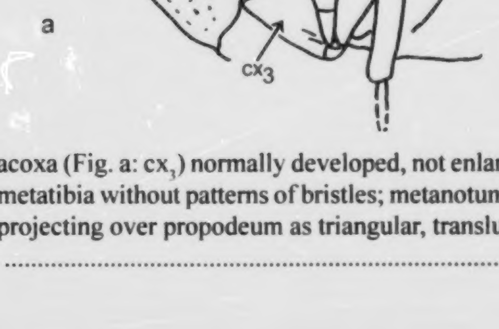
26(12) Propodeum with triangular median area outlined by fine grooves (Fig. a: gr); scutellum (Fig. a: sct) strongly transverse, strap-like and only little longer than metanotum; axillae not visible or only obscurely delineated from scutellum; forewing with membrane virtually devoid of setae, but with long marginal setae (Fig. b) .. .. **SIGNIPHORIDAE** (p. 693)



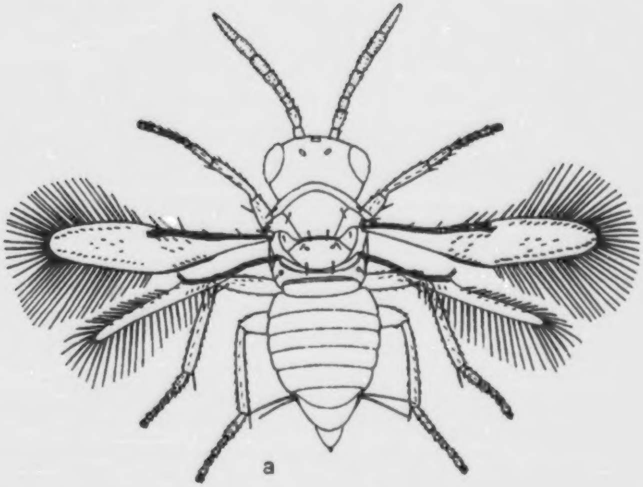
– Propodeum without median triangular area (Fig. a); scutellum usually at least as long as wide (Fig. a: sct) or, if wider than long, anterior and posterior margins not parallel and scutellum much longer than metanotum; axillae (Fig. a: ax) distinct from scutellum; forewing with membrane having numerous setae (Fig. b) and only rarely with long marginal setae 27



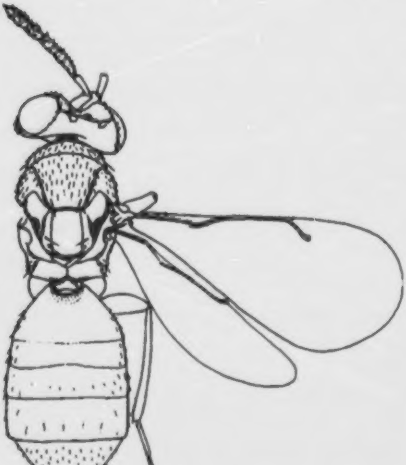
27(26) Metacoxa (Fig. a: cx$_3$) greatly enlarged and flattened, plate-like; metatibia with short bristles forming distinct diamond-shaped or undulating patterns (Fig. c); metanotum (Figs. a, b: no$_3$) projecting as flat, triangular, often translucent plate over propodeum .... **ELASMIDAE** (p. 165)



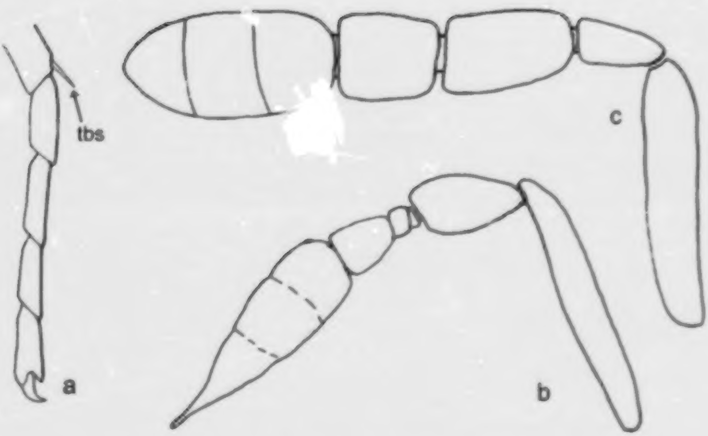
– Metacoxa (Fig. a: cx$_3$) normally developed, not enlarged or flattened; metatibia without patterns of bristles; metanotum (Fig. a: no$_3$) not projecting over propodeum as triangular, translucent plate 28



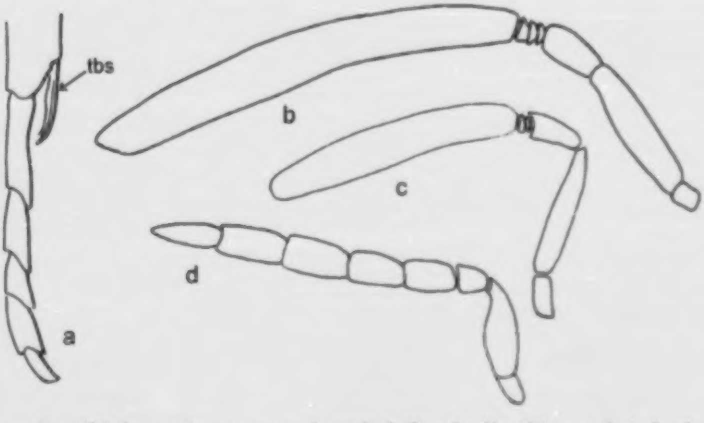
28(27) Tarsi 5-segmented or, rarely, only mesotarsus 4-segmented; metasoma broadly attached to mesosoma (Fig. a), without obvious petiole; body usually less than 2 mm long and not metallic .... **APHELINIDAE** (p. 134)



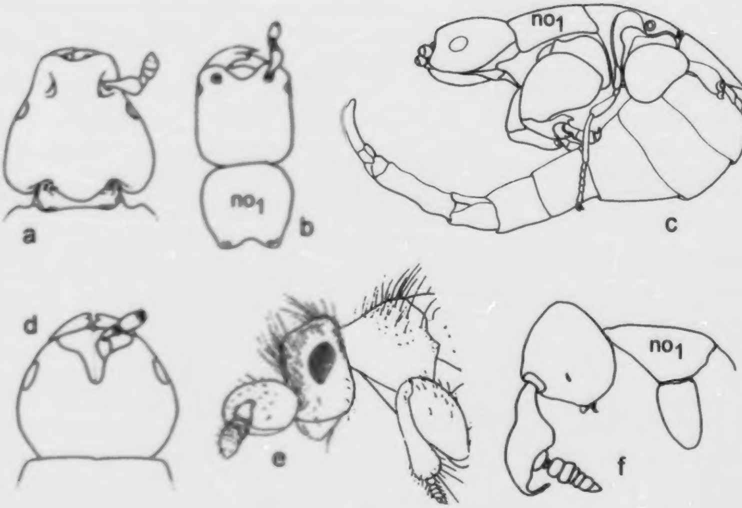
– Tarsi 4-segmented; metasoma usually narrowly attached to mesosoma (Fig. a) and often distinctly petiolate; body usually more than 2 mm long and often metallic 29



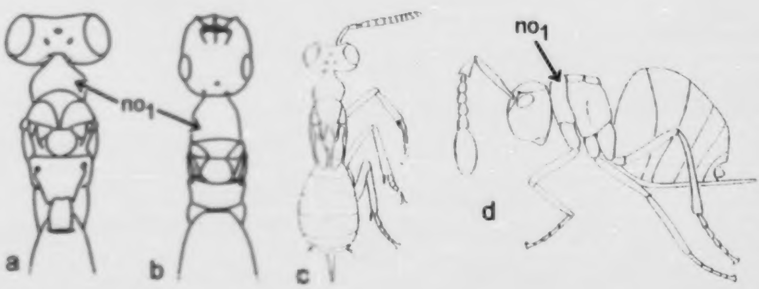
29(28) Protibial spur short and straight (Fig. a: tbs), inconspicuous; body generally more than 1.5 mm long, often with metallic sheen; clava rarely longer than funicle and, if so, then with more than 1 segment (Figs. b, c); scutellum rarely longer than wide, but if so then funicle short with 1 or 2 segments and with obvious clava; commonly collected .... **EULOPHIDAE** (p. 327)



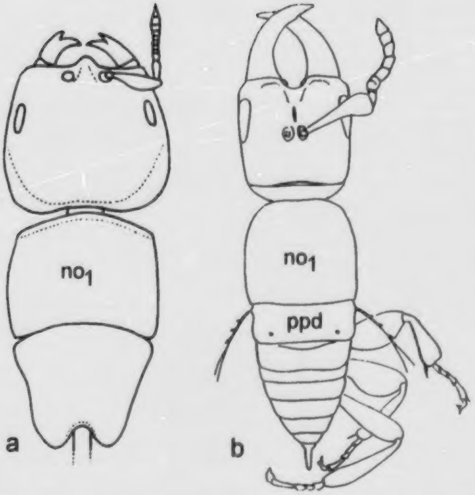
– Protibial spur long, curved, and cleft apically (Fig. a: tbs); body generally 1.5 mm or less, and not metallic; clava 1-segmented and longer than funicle (Figs. b, c) (*Eretmocerus*, *Cales*) or scutellum longer than wide and funicle without obvious clava (Fig. d) (*Pteropterix*); uncommonly collected .... **APHELINIDAE** (*Eretmocerus*, *Cales*, *Pteropterix*) (p. 134)



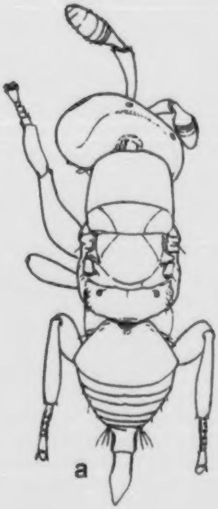
30(1) *Male only*: eyes greatly reduced (Figs. a–d), sometimes as slit-like scars (Fig. f); ocelli not readily apparent, or absent; scape sometimes greatly modified (Figs. e, f); pronotum elongate to shield-like (Figs. b, c, e, f: no_1); body highly modified, not wasp-like 31



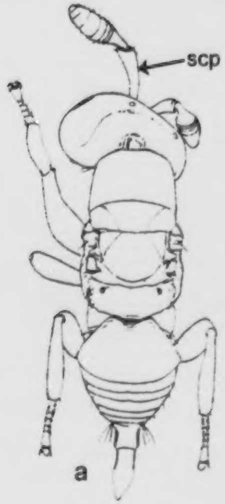
– *Both sexes*: without above combinations of features; eyes usually normal (Figs. a, c), but rarely reduced (Figs. b, d); ocelli apparent (except rarely absent from Mymaridae); scape not modified (Figs. c, d); pronotum usually transverse (Figs. a, d: no_1), but sometimes elongate (Figs. b, c); body ant-like or wasp-like 33



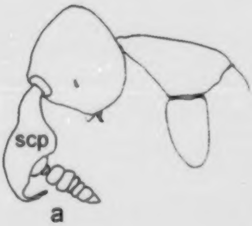
31(30) Mesosoma largely fused behind pronotum (Figs. a, b: no_1), the scutellum and axillae not distinctly separated, but propodeum sometimes apparent (Fig. b: ppd) .... **AGAONIDAE** (p. 117)

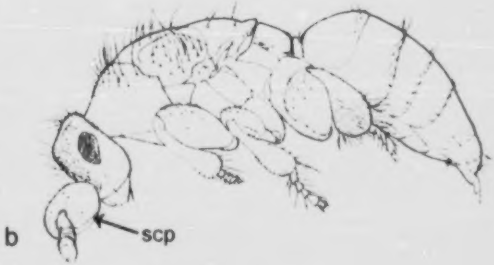


– Mesosoma with distinct pronotum, mesoscutum, scutellum, axillae, and propodeum (Fig. a) 32

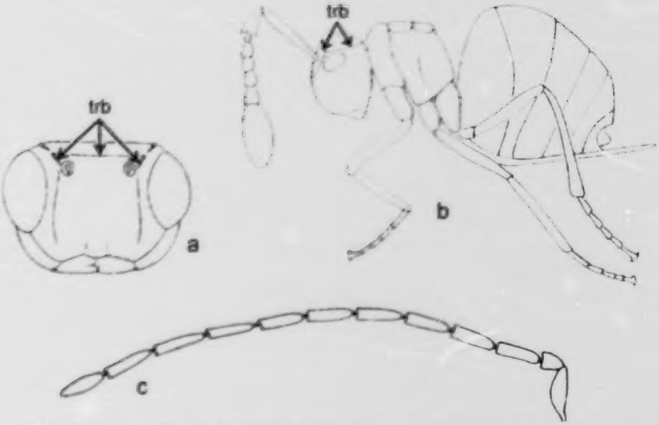


32(31) Scape normal, not expanded or inflated (Fig. a: scp); tarsi 5-segmented .... **TORYMIDAE** (*Physothorax*) (p. 709)

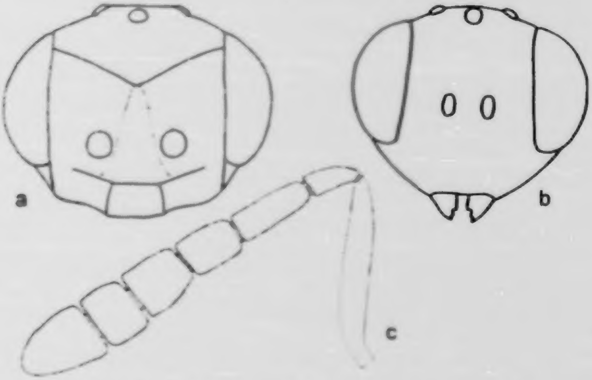




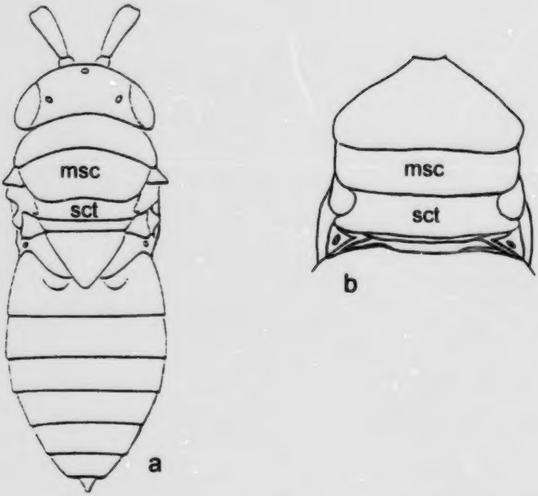
– Scape highly modified, either much expanded apically (Fig. a: scp) or entirely inflated (Fig. b: scp); tarsi 4-segmented (tarsi of one or more legs occasionally 3-segmented) .... **EULOPHIDAE** (*Melittobia*, *Tachinobia*) (p. 327)



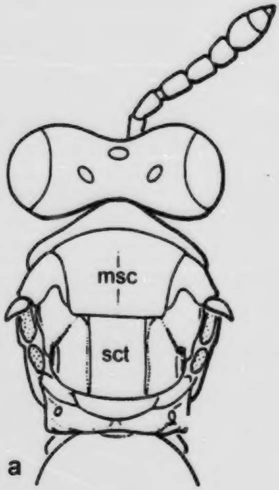
33(30) Head with dark, H-shaped lines on vertex and face (transverse line above toruli usually conspicuous, other lines sometimes difficult to see) (Figs. a, b: trb); toruli above midpoint of face, the distance between toruli at least 3 times distance between torulus and eye margin (Fig. a); body less than 1 mm long. *Male*: flagellum filiform, usually at least as long as body (Fig. c) .... **MYMARIDAE** (p. 499)



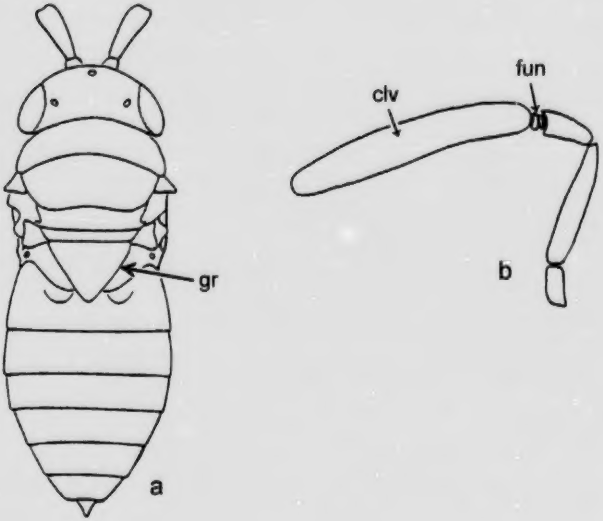
– Head without dark, H-shaped lines on vertex and face (Figs. a, b), sometimes with suture across upper face (Fig. a); toruli below midpoint of face, the distance between toruli less than 2 times distance between torulus and eye margin (Figs. a, b); body variable, but usually longer than 2 mm (except Signiphoridae and Encyrtidae). *Male*: antenna not filiform and usually shorter than body (Fig. c)..34



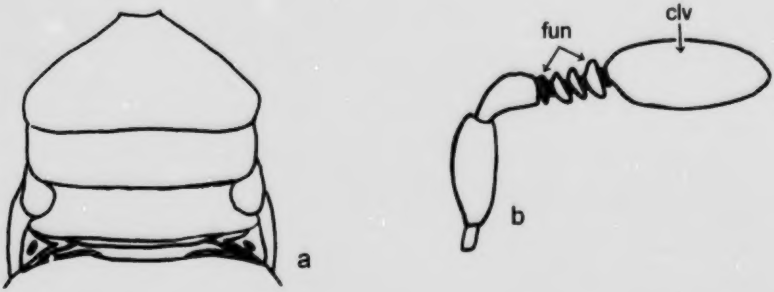
34(33) Mesoscutum (Figs. a, b: msc) and scutellum (Figs. a, b: sct) strongly transverse, with anterior and posterior margins parallel 35



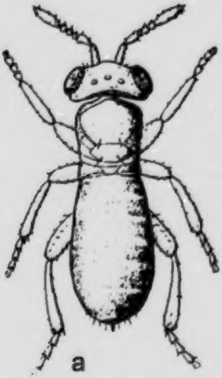
– Mesoscutum and scutellum longer (Fig. a: msc, sct), not transverse and with anterior and posterior margins not parallel 36



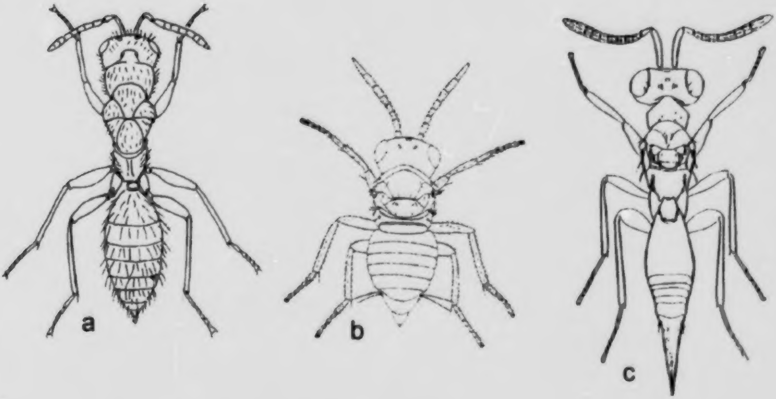
35(34) Tarsi 5-segmented; propodeum with median triangular area outlined by fine grooves (Fig. a: gr). *Female*: flagellum with large unsegmented clava and with funicle very short or apparently absent (Fig. b) .... **SIGNIPHORIDAE** (p. 693)



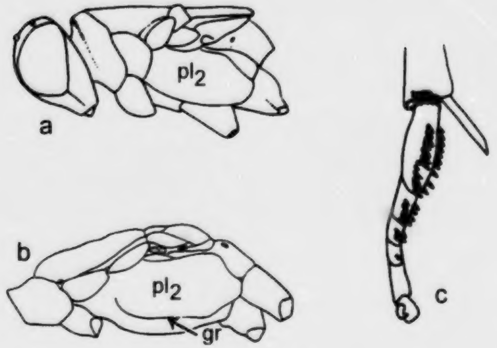
– Tarsi 4-segmented; propodeum reduced, without median triangular area (Fig. a). *Female*: flagellum with shorter clava and longer, 4-segmented funicle (Fig. b) .... **ENCYRTIDAE** (*Tetracyclos*) (p. 170)



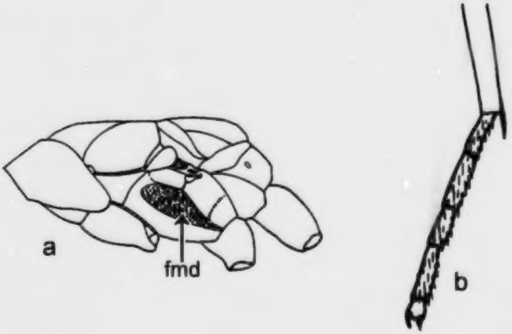
36(34) Tarsi 3-segmented (Fig. a) (easily confused with Aphelinidae, couplet 40; separation based only on tarsal segmentation) .... **TRICHOGRAMMATIDAE** (p. 726)



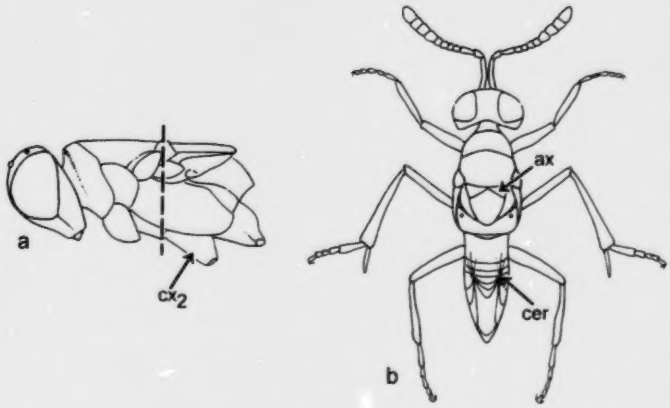
– Tarsi 4- or 5-segmented (Figs. a–c) 37



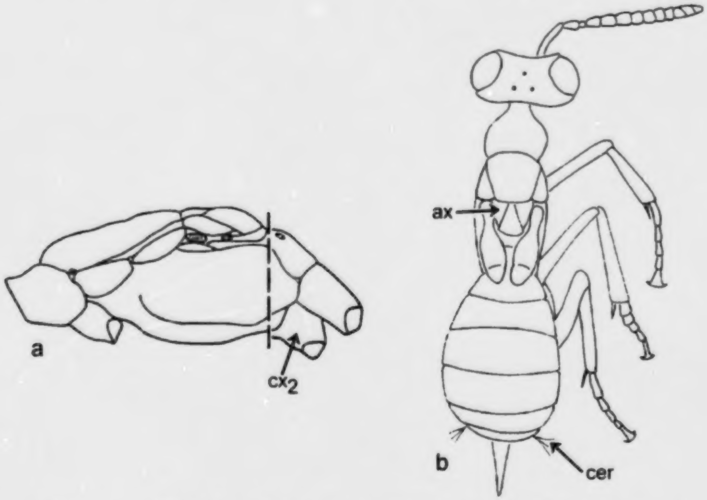
37(36) Mesopleuron evenly convex and longer than high (Figs. a, b: pl_2), sometimes delineated ventrally by longitudinal groove (Fig. b: gr) extending from mesocoxa toward prepectus; mesotibia with thickened apical spur and usually with pegs along inner apical margin (Fig. c); mesotarsus ventrally often with one or more rows of thick pegs, at least on basitarsus (Fig. c) 38



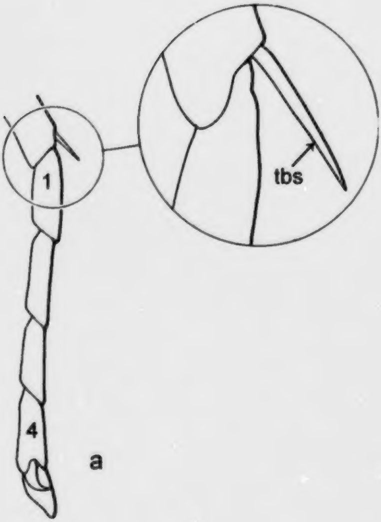
– Mesopleuron partly flat or depressed, usually subquadrate or higher than long, and medially with oblique femoral groove or depressed area (Fig. a: fmd) or pit; mesotibia with thin apical spur and at most with bristles along inner apical margin; mesotarsus at most with bristles ventrally (Fig. b)..39



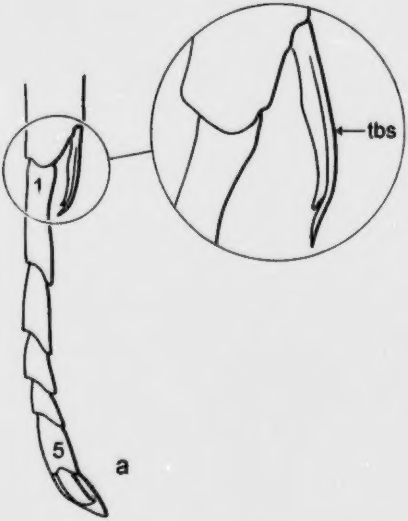
38(37) Mesocoxa (Figs. a: cx_2) inserted anterior to midline of mesopleuron, much closer to procoxa than to metacoxa; axillae acutely transverse-triangular (Fig. b: ax), meeting medially; metasoma with apical terga V-like and cercus advanced anteriorly (Fig. b: cer) .. .. **ENCYRTIDAE** (p. 170)



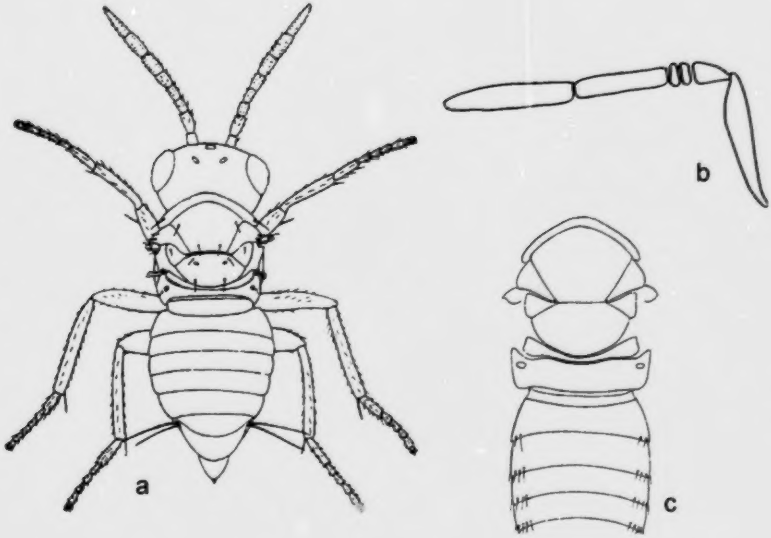
– Mesocoxa (Fig. a: cx_2) inserted posterior to midline of mesopleuron, much closer to metacoxa than to procoxa; axillae equilaterally or longitudinally triangular (Fig. b: ax), often not meeting medially; metasoma with most terga band-like and with cercus near apex (Fig. b: cer) .... **EUPELMIDAE** (p. 430)



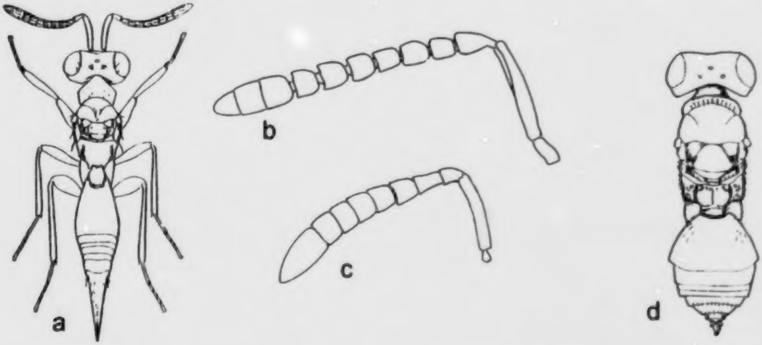
39(37) Tarsi 4-segmented; protibial spur straight and often inconspicuous (Fig. a: tbs) .... **EULOPHIDAE** (p. 327)



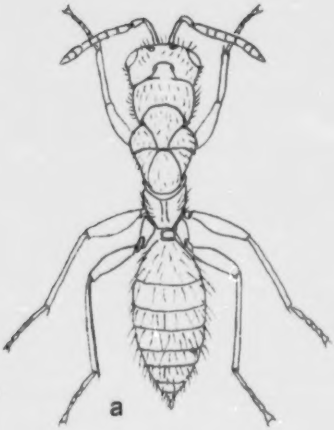
– Tarsi 5-segmented; protibial spur curved and conspicuous (Fig. a: tbs) 40



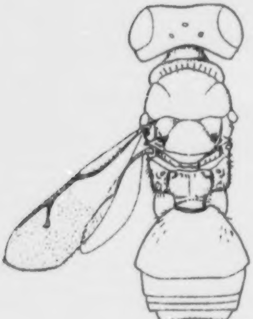
40(39) Antenna with fewer than 5 apparent funicular segments (Figs. a, b); metasoma broadly attached to mesosoma (Figs. a, c) .... **APHELINIDAE** (p. 134)

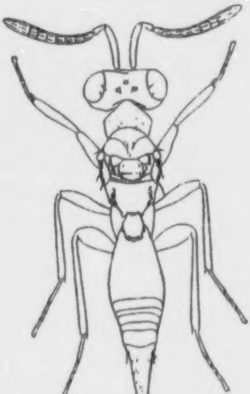


– Antenna with 5 or more funicular segments of varied lengths (Figs. a–c); metasoma more narrowly attached to mesosoma (Figs. a, d) 41



41(40) Body, especially metasoma, covered with long setae (Fig. a) .... **EURYTOMIDAE** (some *Tetramesa*) (p. 477)





– Body largely bare, at most dorsum of head and apex of metasoma with setae (Figs. a) .... **PTEROMALIDAE** (p. 541) (most commonly *Dipara*, *Cea*, *Spalangiopelta*, *Notanisus*, *Nasonia*)

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Chapter 4. AGAONIDAE

Zdenek Bouček

Recognition/Systematics. Agaonidae, as presently recognized (Bouček 1988, 1993), cannot be defined unequivocally by the presence of unique morphological features. So far, the separation of Agaonidae from other families appears to be supported by only one feature — glands attached to the ovipositor — generally of one type in groups classified in Agaonidae, which are different from the glands found in other chalcidoids (Copland et al. 1973). In addition, all groups currently assigned to Agaonidae, whose biology is known, are phytophagous. All are associated with the fruits of *Ficus*, some as inquilines, others as gall formers. Agaonidae include the fig-pollinating Agaoninae and the non-pollinating Epichrysomallinae (introduced into the New World), Otitesellinae, Sycoryctinae, Sycoecinae (extralimital), and Sycophaginae.

Morphologically, the Agaonidae are heterogenous and some or all subfamilies were until recently classified in Torymidae (e.g., Burks 1979), probably because most female agaonids have a long ovipositor. Most members of Agaonidae, however, lack certain features that distinguish most Torymidae, such as a horseshoe-shaped occipital carina (also missing in a few Torymidae, but present in two Australasian genera of Epichrysomallinae). Agaonids also do not have the long marginal vein and short stigmal vein that characterize most torymids (venation of normal proportions in a few genera of Torymidae) and females do not have a strongly reduced dorsal part of Mt_8 (Gt_7). Agaonidae and Torymidae share elongate cerci, which seems to be a feature related to a long ovipositor that is possessed by almost all Torymidae and most Agaonidae. The presence of two, mostly-well-developed spurs on the metatibia of Agaonidae is a primitive feature. There are often fewer than 13 antennal segments but this feature apparently evolved independently in several groups within the Agaonidae.

Otitesellinae and Epichrysomallinae were once considered as members of Pteromalidae (Bouček et al. 1981). Their separation from Pteromalidae is subtle and needs further study. The New World genera *Aepocerus* and *Heterandrium*, presently classified in Otitesellinae, are particularly difficult to distinguish from Pteromalidae.

Relationships within Agaonidae and between Agaonidae and other Chalcidoidea are often greatly obscured by convergences and reversals of certain conspicuous features that have evolved in response to the peculiar life in figs. The morphology of females is also affected by whether oviposition takes place inside the fig or from the outside, through the fig wall. Females that oviposit inside the fig have a smooth body and modifications that prevent them from slipping back when penetrating into the fig cavity through the ostiole. Another difficulty in determining relationships is caused by wingless or short-winged males, which are completely different from females and also unlike individuals of any other chalcidoid family. For the extreme variety of forms see the illustrations at the end of this chapter.

Agaoninae is undoubtedly the most specialized subfamily. The main synapomorphies are: in females, the presence of a mandibular appendage, a peculiar antenna with a usually tooth-like third segment, and a channelled head (Figs. 29, 37); in males, a characteristic head and a telescoping metasoma that is bent forward under the body (Fig. 28). Agaoninae seem to be the sister group of the Sycophaginae (Bouček 1988, Ramirez 1991), which like all the non-agaonine subfamilies, are non-pollinators. There is little doubt that Sycophaginae are also closely related to Sycoryctinae and the Paleotropical Sycoecinae, as was suggested by Bouček (1988), accepted by Ramirez (1991), and as being confirmed by a contemporaneous study by S. van Noort in South Africa. The African genus *Philocaenus* Grandi (Sycoecinae) has developed mandibular appendages similar to Agaoninae. The females of some Oriental genera of Otitesellinae (e.g., *Eujacobsonia* Grandi) are apparently adapted to penetration into figs through the ostiole and show great similarity to Sycoecinae (Bouček 1988). The subfamily Epichrysomallinae has the ovipositor concealed, coiled in the gaster and rather long, and has ovipositor glands similar to those of members of other agaonid subfamilies (Copland et al. 1973). Otherwise the epichrysomalline body reminds one of a eurytomid, but it lacks the coarse sculpture of most members of Eurytomidae. It still seems premature to identify the outgroup or outgroups of the fig wasps because the whole complex badly needs more taxonomic study. Restricting the concept of the family to Agaoninae and leaving the non-pollinating groups unplaced is unsatisfactory.

Biology. Among the subfamilies, Agaoninae have developed the closest symbiosis with fruit of *Ficus* (Moraceae). In the ripening syconium males appear first, mate with maturing females while these are still in their pupal skin, then chew an opening through which the females leave the fig, after having taken on their body pollen from the ripe anthers. Some species developed adaptations for carrying pollen — small pockets on their mesopleura (Fig. 37) or depressions combined with setal groups, mainly on the procoxae. The males die in the fig, whereas the females fly away. Females are attracted to the figs in the right stage of development by pollinator-specific attractant volatiles released by the fig (van Noort et al. 1989). Females penetrate the fig through the ostiole whose bracts let them in but not out; usually females lose their wings and parts of limbs during entry. After pollination and oviposition into the ovaries of female florets (as in *Pegoscapus*) they die in the fig (Frank 1984).

Species of some exotic genera of other subfamilies also penetrate the fig through the ostiole but most other fig wasps oviposit from the outside, through the wall of the fruit. Biology of these groups is certainly varied, but at least some species of all the subfamilies of non-pollinating fig wasps are known to be gall formers, galling the ovaries of female florets as Agaoninae do, but causing larger galls. Some others may be inquilines feeding on fig tissues (e.g., *Philotrypesis*), and one species of *Acophila* Ishii (Epichrysomallinae), found recently in Hawaii, is believed to produce galls on leaves of a *Ficus*.

Fauna. Fig wasps are generally tropical insects and the native New World fig fauna is less diverse compared with that of the Old World. Only five native genera occur in southern USA, mainly in Florida. However, many *Ficus* have been introduced into the Nearctic region as ornamental trees and some of the inhabitants of the figs were introduced as a result. These immigrants, representing a further six genera, are included in the key. A few Neotropical genera, such as *Tetrapus* and *Critogaster*, are also included in the key because they are known from Mexico and may eventually be found in southern United States. The fig galls, whether caused by non-pollinating Agaonidae or by Cecidomyiidae (*Ficiomyia* Felt) attract torymid parasites, in Florida of the genus *Physothorax*. One species of *Physothorax* from Florida has wingless males that could be mistaken for agaonids, so it is included in the key to agaonid genera.

Literature. See Bouček (1988, 1993) for recent synonymy in Agaonidae and Wiebes (1986) for taxonomy of *Ficus* in association with fig wasps.

Key to genera of Agaonidae

1 *Female* or, *if male*, fully winged [**note**: females often loose their wings when entering the fig fruit] 2

– *Male*: wingless or wings greatly reduced (Figs. 6, 7, 14, 23, 28) 16

2(1) *Female*: mandible with flat appendage adhering to underside of head, the appendage having transverse laminae or 2 rows of teeth (Figs. 26, 29); head prognathous, with occipital foramen close to vertex; face with median part membranous, pale, and collapsed in air-dried specimens; antenna with scape irregularly broadened (Figs. 27, 33), with pedicel hardly movable, and with third segment (often appearing as fourth segment) usually with acuminate projection and not anelliform; ovipositor sheaths protruding (Fig. 36) (pollinating fig wasps) .... AGAONINAE, 3

– *Both sexes*: mandible without appendage; head mostly orthognathous, with occipital foramen far from vertex; face uniformly sclerotized; antenna always different, with scape slender or slightly clavate, with pedicel freely movable, and with third or fourth segment without projection and anelliform or not; ovipositor sheaths protruding or not (non-pollinating fig wasps) 8

3(2) Mandibular appendage with row of sharp teeth on outer and inner margins (Fig. 26); flagellum filiform, with segments compact, appearing bare, and with longitudinal sensilla not raised above surface; forewing venation partly reduced (Fig. 27), without stigmal vein; head always longer than broad .... ***Tetrapus*** Mayr

Fauna: Neotropical, several spp. in Mexico but so far none found in USA. **Hosts**: *Ficus*, subgenus and section *Pharmacosycea*.

– Mandibular appendage ventrally with transversely arcuate laminae, low at sides but higher in middle, hence appendage appearing serrate in lateral view (Fig. 29); flagellum slightly to distinctly clavate, with segments well separated and mostly with conspicuous longitudinal or trichoid sensilla (Figs. 32, 36); venation varied, complete with postmarginal and stigmal veins, to strongly reduced (in *Eupristina*); head often short 4

4(3) Head longer than broad; gena more than twice as long as eye; mandibular appendage as long as width of head, with about 20 transverse lamellae; forewing densely setose, with venation distinct; antenna slender .... ***Pleistodontes*** Saunders

Key: Wiebes (1991). **Fauna**: 1 sp., *P. greenwoodi* (Grandi), in USA (CA). **Hosts**: introduced *Ficus obliqua* and *F. archeri*.

– Head broader than long; gena much shorter; mandibular appendage short, with at most about 13 lamellae; forewing with setation and venation often indistinct; antenna in most species not very slender 5

5(4) Flagellum only very slightly clavate, most segments with distinct setae at apex but with longitudinal sensilla inconspicuous, low, short, and not exceeding apex of each segment; forewing slightly infumate and extensively setose, with well pigmented venation including postmarginal vein and curved, clavate stigmal vein (Fig. 24); ovipositor shorter than metafemur; mesopleuron convex, without pollen pockets .... ***Blastophaga*** Gravenhorst

Fauna: 1 introduced sp., *B. psenes* (L.), in USA (AZ, CA). **Hosts**: *Ficus carica* (Smyrna fig).

– Flagellum moderately to distinctly clavate, with conspicuous longitudinal or trichoid sensilla exceeding apex of each segment (Figs. 29, 36), and with indistinct setation; forewing hyaline, without conspicuous setation, with venation in most species partly reduced and pale or indistinct, and with stigmal vein almost straight and at right angle to wing margin; ovipositor often longer than metafemur; mesopleuron usually with pollen pockets (Fig. 36) 6

6(5) Venation with at least marginal and stigmal veins developed (Fig. 36) although sometimes weakly pigmented, the stigmal vein often longer than marginal vein; on native *Ficus* .... ***Pegoscapus*** Cameron

Keys: Stange and Knight (1987) and Wiebes (1995*a*). **Fauna/Hosts**: 2 spp., *P. mexicanus* (Ashmead) on *Ficus aurea* and *P. franki* Wiebes on *F. citrifolia*, in USA (FL) (the genus, with many Neotropical spp., is associated exclusively with *Ficus*, subgenus *Urostigma* section *Americana*). [See Frank (1984) for behavior and Wiebes (1983, 1995*a*) for taxonomy.]

– Venation reduced but submarginal vein clavate at apex and, of the remaining veins, only apex of stigmal vein sometimes traceable (Fig. 30); on introduced *Ficus* .... ***Eupristina*** Saunders, 7

7(6) Ovipositor sheaths almost as long as body; flagellar segments with strong longitudinal sensilla (Fig. 29) .... ***Eupristina (Eupristina*** Saunders)

Key: Wiebes (1992). **Fauna/Hosts**: at least 2 spp. introduced from South Asia, *E. masoni* Saunders on *Ficus benghalensis* in USA (FL) and *E. altissima* Balakrishnan & Abdurahiman on *F. altissima* in USA (CA, FL).

– Ovipositor sheaths shorter than gaster; flagellar segments without longitudinal sensilla but, except for basal 2, each segment with whorl of long black trichoid sensilla, the apical part of flagellum thus appearing as hairy club in dried specimens (Figs. 32, 33) ... . ***Eupristina (Parapristina*** Hill)

Fauna: 1 sp., *E. verticillata* Waterston, introduced from southeast Asia into USA (FL) (also in Bermuda and Mexico). **Hosts**: *Ficus microcarpa*.

8(2) Scutellum with quadrate dorsal area delimited laterally by subparallel, straight, or concave axillular grooves and posteriorly by straight frenal groove (Fig. 20); ovipositor sheaths at least as long as half length of gaster; [antenna with 1 or 2 anelli]; on native *Ficus* .... SYCOPHAGINAE, 9

– Scutellum rounded to oval, the axillular grooves not conspicuous dorsally and without frenal groove; ovipositor sheaths concealed or protruding; on either introduced or native *Ficus* 10

9(8) Postmarginal vein virtually absent (Fig. 22); torulus high on face, about level with upper third of eye; scape exceeding level of vertex; scutellum convex, with axillular grooves deep, broad, and delimited by high carina on outer side; ovipositor shorter than gaster (Fig. 22); body brown to yellow .... ***Anidarnes*** Bouček

Key: Bouček (1993). **Fauna**: 1 sp., *A. bicolor* (Ashmead), in USA (FL). **Hosts**: *Ficus aurea*.

– Postmarginal vein present (Fig. 20), at least as short translucent stub; torulus in middle of face, either at level of middle of eye or at lower margin of eye; scape not exceeding vertex; scutellum flat or nearly so, the axillular grooves normal, without carina on outer side; ovipositor of varied length, mostly longer than body; head and mesosoma of most species with metallic sheen .... ***Idarnes*** Walker

Key: Gordh (1975). **Fauna/Hosts**: 3 spp. in USA (FL), including *I. carme* Walker, with metallic sheen, long ovipositor, and wingless males, mainly on *F. aurea*, and *I. incerta* (Ashmead), with yellowish body, very short ovipositor, and winged males.

10(8) Stigmal vein virtually at right angle to wing margin and about as long as marginal vein, the postmarginal vein very short and stub-like (Fig. 4); body brown to yellow, shiny; thorax with sparse, paired setae; tarsi 4-segmented. *Male*: eye small; mandible often long and bidentate (Fig. 3); gaster petiolate; metacoxa large and toothed (Fig. 2) .... EPICHRYSOMALLINAE, ***Odontofroggatia*** Ishii

Key: Wiebes (1980). **Fauna**: 2 spp., *O. galili* Wiebes and *O. ishii* Wiebes, introduced from southeast Asia into USA (CA, FL). **Hosts**: galling seed ovaries on *Ficus microcarpa*.

– Stigmal vein more or less at acute angle to wing margin and shorter than marginal or postmarginal veins (Figs. 9, 13, 15); body often with metallic colors and with denser though not always conspicuous setation; tarsi 5-segmented. *Male*: different (Fig. 16) 11

11(10) *Female*: gaster abruptly narrowed into a tail formed by long ovipositor sheaths at least partly covered dorsally by 1 or 2 extended apical terga (Figs. 15, 17); notauli complete. *Male*: stigmal vein shorter than one-quarter length of marginal vein (as in Fig. 15) .... SYCORYCTINAE, 12

– *Female*: gastral tail absent or, if present, formed only by ovipositor sheaths, the last tergum very short and bearing cerci (Fig. 13); notauli complete or incomplete. *Both sexes*: stigmal vein mostly longer than one-third length of marginal vein .... OTITESELLINAE, 13

12(11) Gastral tail consisting of a broader anterior part formed by last 2 narrowed terga and a narrow posterior part formed only by ovipositor sheaths (Fig. 15); notauli shallow. *Male*: pronotum longer than mesoscutum; petiole indistinct .... ***Philotrypesis*** Förster

Fauna: 1 sp., *P. emeryi* Grandi, in USA (FL). **Hosts**: *Ficus microcarpa*.

– Gastral tail thin and undivided, its whole length covered by extended last tergum (Fig. 17), only apex usually slightly broader (Fig. 18); notauli deep. *Male*: pronotum shorter than mesoscutum; petiole conspicuous (Fig. 16)...................................... ***Critogaster*** Mayr

Key: Bouček (1993). **Fauna**: species reach Mexico but not yet found further north. **Hosts**: *Ficus*, subgenus and section *Pharmacosycea*.

13(11) *Female*: notauli incomplete, very shallow and traceable only in anterior half of mesoscutum; ovipositor sheaths at most slightly protruded, shorter than Gt_6 dorsally (Fig. 5) 14

– *Both sexes*: notauli complete, linear to furrow-like; ovipositor sheaths often much longer (Figs. 9, 13) 15

14(13) Antenna with 3 anelli; distance between toruli at least as great as diameter of torulus; head and thoracic dorsum with sculpture very fine, but lower face with conspicuous setiferous punctures; propodeum without median carina; apex of gaster and ovipositor sheaths distinctly bent downward .... ***Micranisa*** Walker

Fauna: 1 unidentified sp. in USA (FL) (see Stange and Knight 1987). **Hosts**: *Ficus microcarpa*.

– Antenna with 2 anelli, though only one sometimes apparent; distance between toruli less than diameter of torulus; head and thoracic dorsum with sculpture consisting of fine raised reticulation (appearing rather dull), the lower face with inconspicuous setiferous punctures; propodeum with median carina; ovipositor sheaths almost horizontal .... ***Walkerella*** Westwood

Fauna: 1 sp., *W. microcarpae* Bouček (1993), introduced from paleotropics into USA (FL). **Hosts**: *Ficus microcarpa*.

15(13) *Female*: torulus high above lower margin of eye; antenna 13-segmented, with 3 anelli (Fig. 13); scrobal depression usually including anterior ocellus; propodeum with costula and distinct median carina, often also with plicae; ovipositor sheaths hardly to obviously exserted; thorax (and head) with raised reticulation and at least some short, white setae .... ***Aepocerus*** Mayr

Fauna: 1 sp., *A. nadelae* Bouček (1993), in USA (FL) (Neotropical genus with many spp., several reaching Mexico). **Hosts**: *Ficus citrifolia*.

– *Both sexes*: torulus at or below lower margin of eye (Fig. 9); antenna at most 12-segmented, with 1 or 2 anelli; scrobal depression not reaching anterior ocellus; propodeum smooth, without carinae, flat and shiny medially; ovipositor sheaths more or less protruding, at least two-thirds length of metatibia; thorax shiny, with at most engraved reticulation and sparse, erect setae .... ***Heterandrium*** Mayr

Key: Bouček (1993). **Fauna/Hosts**: 2 spp. in USA (FL) on native *Ficus*: *H. rasplusi* Bouček on *Ficus citrifolia*, and *H. nudiventre* Mayr on *F. aurea* and *F. citrifolia* (mainly Neotropical genus).

16(1) Mesosoma with distinct pronotum, notauli, scutellum, axillae, and propodeum (Fig. 23); head parallel-sided, with toruli situated behind anterior quarter and close to each other; flagellum shorter than scape, in form of ovoid cone; wings replaced by tubercles (Fig. 23) .... ***Physothorax*** Mayr (TORYMIDAE)

Keys: Burks (1969) and Bouček (1993). **Fauna**: 1 sp., *P. pallidus* Ashmead, in USA (FL). **Hosts**: parasite in fig galls caused either by Agaonidae in figs of *Ficus aurea* or by *Ficiomyia perarticulata* Felt (Cecidomyiidae) in walls of figs on *Ficus citrifolia*. See chapter 21 for other species of *Physothorax*.

– Mesosoma more or less fused posterior to distinct pronotum, the notauli, scutellum, axillae, and often propodeum, not visible as separate sclerites; head and/or antenna of different shape; wings of some species filament-like (Figs. 6, 7) 17

17(16) Gaster with soft posterior half telescoping, recurved forwards in ∪-shape under body (Fig. 28); head with sides rounded and converging; antenna short and partly hidden in cavity close to mouth margin (Figs. 31, 34, 35); pronotum long, with side high and concave to receive greatly enlarged profemur (Fig. 28); metafemur enlarged .... AGAONINAE, 18

– Gaster at most slightly bent downwards at apex, never recurved forwards under body, its segments not telescoping; head with sides mostly less rounded, often parallel; antenna longer and exposed, not hidden in cavity (e.g., Fig. 21); pronotum quadrate to slightly transverse, without lateral cavity for profemur; femora never unusually large 23

18(17) Middle legs almost absent, represented only by tiny 1- or 2-segmented rudiments (Fig. 28); head subglobose, with scrobal depression strongly transverse .... ***Tetrapus***, see 3

– Middle legs well developed, although usually weaker than others; head subglobose or dorsally depressed, with scrobal depression subtriangular 19

19(18) Facial cavity divided medially by interantennal septum (Figs. 34, 37) 20

– Facial cavity not divided medially 21

20(19) Head in dorsal view broadend behind eyes (Fig. 34) and dorsally flattened; interantennal septum broadening posteriorly; pronotum with anterior corners rounded and sides slightly sinuate; body entirely yellowish .... ***Eupristina (Parapristina)***, see 7

– Head in dorsal view almost parallel-sided (Fig. 37) and not flattened; interantennal septum thin throughout; pronotum with anterior corners right-angled and sides straight and parallel; head dark, rest of body pale yellow .... ***Pleistodontes***, see 4

21(19) Head with distinct median groove extending from ∨-shaped facial cavity to posterior margin (Fig. 31) .... ***Eupristina (Eupristina)***, see 7

– Head without long median groove (Figs. 25, 35) 22

22(21) Eye touching base of mandible (Fig. 35); head shiny, smooth, with sparse punctures; facial cavity medially excised posteriorly .... ***Pegoscapus***, see 6

– Eye separated from base of mandible (Fig. 25); head slightly dull because of conspicuous and fairly dense setiferous punctation; facial cavity with median channel rounded posteriorly .... ***Blastophaga***, see 5

23(17) Tibiae short and broad, dorsally with numerous stout spines (Fig. 21); wing stumps absent 24

– Tibiae different, never covered with stout spines; wing stumps sometimes present 25

24(23) Head almost parallel-sided, the temples posteriorly rounded (Fig. 21); labiomaxillary complex absent; mandibles with 2 or 3 teeth .... ***Idarnes***, see 9

– Head distinctly broadening posteriorly, the temples posteriorly with sublateral emarginations (Fig. 19); labiomaxillary complex present; mandibles with 3 or 4 teeth .... ***Critogaster***, see 12

25(23) Torulus close to mouth margin (Fig. 14); scape not or only slightly clavate and not very flat (Figs. 10, 14) 26

– Torulus far from mouth margin, behind anterior third of head; scape broadened and flat (Figs. 6–8) 27

26(25) Propodeum and mesoscutum separated by fine dark line, both sclerites smooth, with scattered setae, and propodeum posteriorly broadly truncate (gaster broadly sessile); anterior margin of pronotum and metatibia without long setae (Fig. 14); toruli in common depression .... ***Philotrypesis***, see 12

– Propodeum and mesoscutum united as convex undivided pubescent shield, the shield posteriorly emarginate to receive distinct petiole-bearing gaster (Fig. 11); anterior margin of pronotum with row of long setae (Fig. 10); metatibia and base of tarsus with very long setae; toruli not in depression .... ***Heterandrium***, see 15

27(25) Head subquadrate (Fig. 6), dorsally depressed; toruli close to each other; scape flat and clavate, tapering to base .... ***Walkerella***, see 14

– Head transverse, subglobose (Fig. 8); toruli far apart, much nearer to eyes than to each other, the space between them convex; scape foliaceous, usually almost quadrate .... ***Micranisa***, see 14

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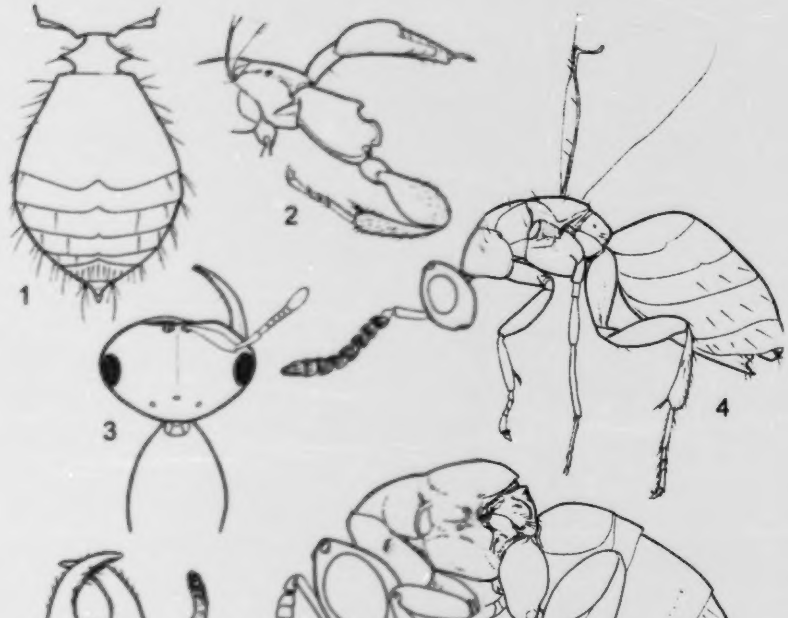

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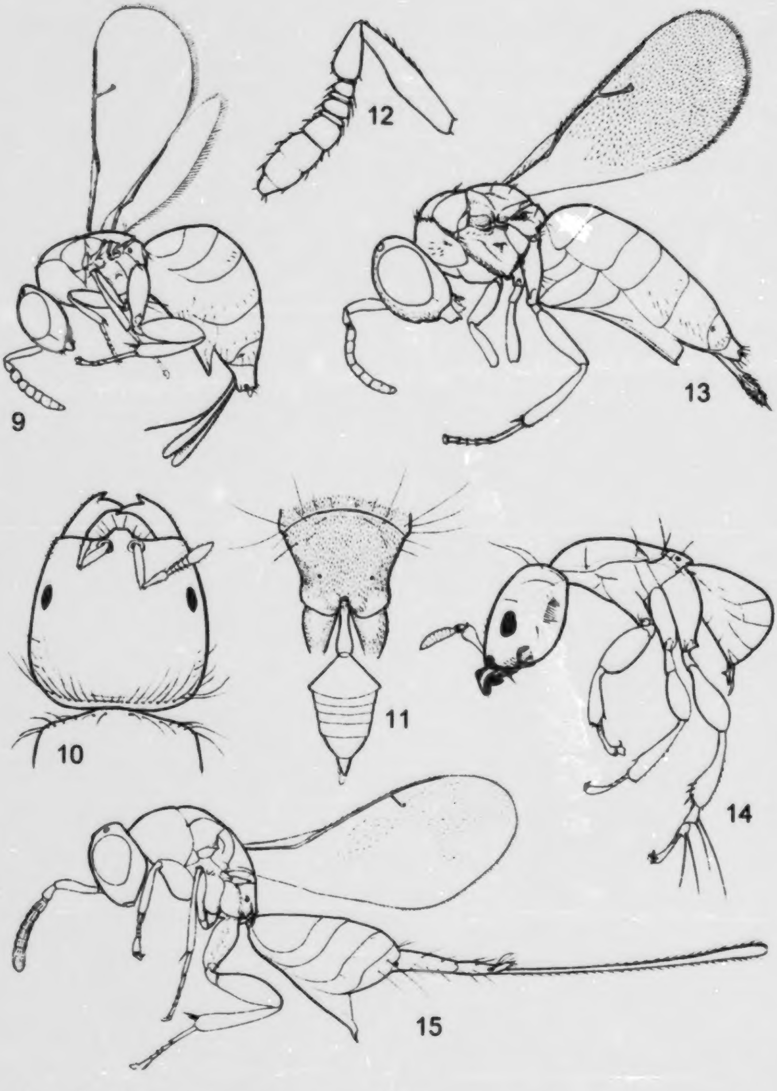

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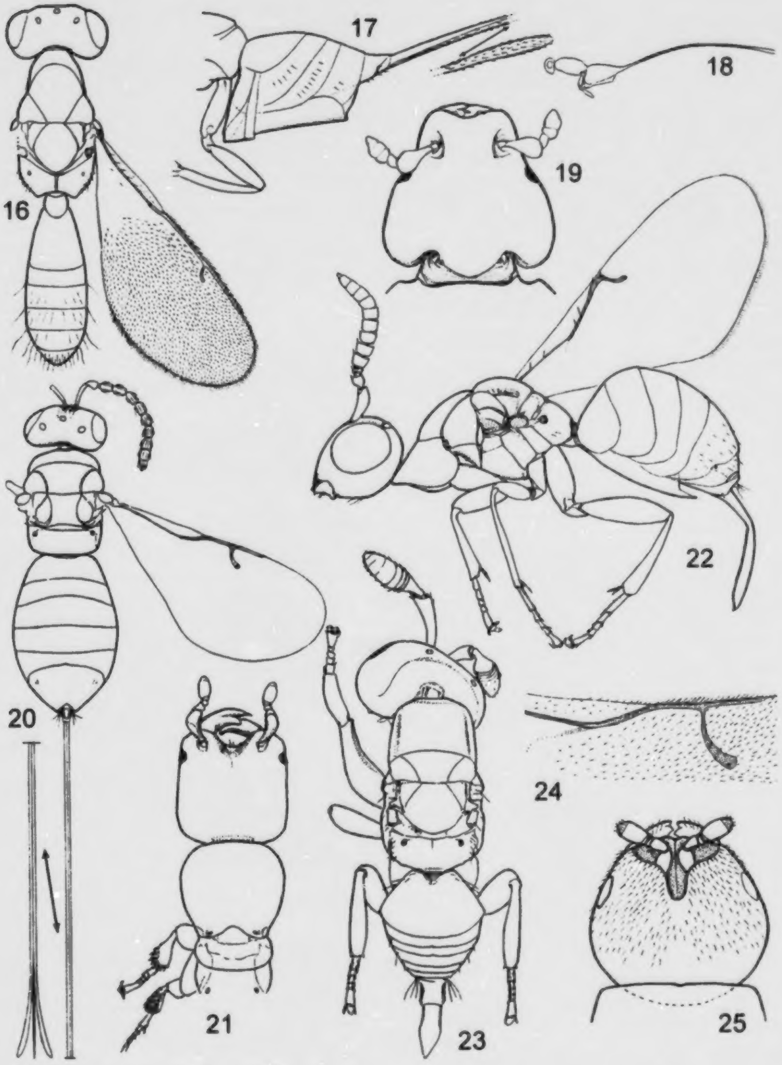

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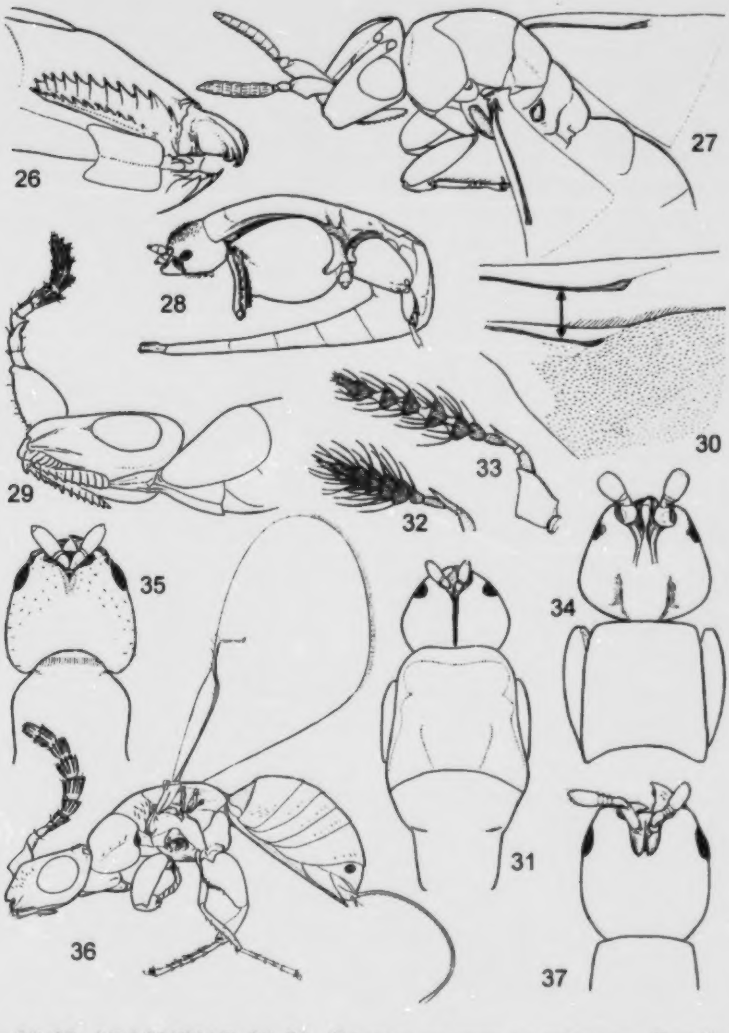

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Chapter 5. **APHELINIDAE**

James B. Woolley

Recognition. Nearctic Aphelinidae are recognized by the following combination of features: small to minute, length 2 mm or less; body never strongly metallic, usually pale or lightly sclerotized; flagellum with 4–6 segments and often with a minute anellus, the funicle in female with at most 4 segments, and flagellum in male without differentiated clava; notauli complete, more or less straight, and widely separated at transscutal articulation; foretibia with curved, cleft spur; tarsal formula 5, 5, 5, or 5, 4, 5, or 4, 4, 4; forewing with combined length of parastigma and marginal vein usually longer than submarginal vein, but never much shorter; postmarginal vein often absent, but if present not longer than stigmal vein; metasoma broadly joined to mesosoma, cerci at apex of metasoma or only slightly advanced (*Coccobius* only).

Systematics. Monophyly of the family is not certain, but Gibson (1989) hypothesized that the structure of the mesotrochantinal plate and metasternum indicates the monophyly of Aphelinidae + Signiphoridae. Woolley (1988) provided putative synapomorphies that support a sister group relationship of Signiphoridae and Azotinae, a subfamily of Aphelinidae. Aphelinidae has often been a repository for taxa of unknown affinities, particularly if they are parasites of Homoptera. *Cales* was originally placed in Aphelinidae (as Aphelininae in Chalcididae) by Howard (1907). Others have placed *Cales* in Trichogrammatidae (Mercet 1929) or Mymaridae (as *Diaspidophilus* Brèthes) (Brèthes 1914). Hayat (1994) removed *Cales* from Aphelinidae, but he did not place it in another family. I include *Cales* in the key because it may commonly be encountered with other aphelinids in samples of whitefly parasites. The Eriaporinae have often been placed in Aphelinidae, although as Gibson (1989) and others have noted, they probably do not belong in the family. This group is largely Old World in distribution; one species of *Myiocnema* may have been introduced into California (Gordh 1979) and I include this species in the key.

Yasnosh (1976) provided the most comprehensive discussion of phylogenetic relationships in the family. She classified the family into seven subfamilies. Other workers have used a great variety of classifications, with from 3 to 8 subfamilies, which they often defined differently. The keys of Hayat (1983) and Yasnosh (1983) can be used to identify most North American or extralimital species to genus. Hayat (1994) provided a synopsis of various classifications and current synonymies for genera, which I have followed here. In particular, Hayat (1994) reestablished the synonymy of *Azotus* Howard (as a junior synonym of *Ablerus*) and he treated *Euxanthellus* Silvestri as a junior synonym of *Coccophagus*. Viggiani and Garonna (1993) treated *Archenomus* Howard as a junior synonym of *Pteroptrix*. Viggiani and Mazzone (1979) treated *Aspidiotiphagus* Howard, and Hayat (1983) treated *Aleurodiphilus* DeBach and Rose, as junior synonyms of *Encarsia*. Although not all workers agree (Yasnosh 1983), the synonymies seem prudent until the phylogenetic relationships of *Encarsia* and its relatives are better understood. Four other genera included in the family (as Aphelininae in Encyrtidae) by Gordh (1979) were treated as junior synonyms by Hayat (1983): *Aneristus* Howard (under *Coccophagus*), *Mesidia* Förster (under *Aphelinus*), *Physcus* Howard (under *Coccobius*) and *Tumidiscapus* Girault (under *Centrodora*).

Biology. Most Aphelinidae are primary parasites or hyperparasites of Homoptera, although species in several genera are known to be parasites of eggs of insects in various orders (Polaszek 1991). Host relationships are reasonably consistent within genera. For example, species of *Aphytis* are invariably primary, external parasites of Diaspididae, and species of the related genus *Aphelinus* are invariably primary, internal parasites of Aphididae. In contrast, species of another related genus, *Marietta*, are almost always external hyperparasites of several families of Homoptera.

Reproduction of aphelinids is commonly biparental, but uniparental reproduction is also common and in many cases it is known to be caused by the bacterium *Wolbachia* (Stouthamer and Luck 1991, Zchori-Fein et al. 1992, Stouthamer et al. 1993). Of particular interest are the divergent biologies (termed 'heteronomous' by Walter 1983) of males and females found in virtually all species of Physcinae, Coccophaginae, and Prospaltellinae (sensu Yasnosh 1976). In 'diphagous parasitoids' (Walter 1983), female larvae are primary internal parasites and male larvae are primary external parasites of Homoptera. This type of biology occurs in some species of *Coccophagus* and *Prococcophagus* Silvestri. Far more common are cases in which female larvae are primary internal parasites and male larvae are either internal or external hyperparasites, developing on their own or other species. Walter (1983, 1988) provided very useful reviews of the large and confusing literature on these phenomena, and called species with this biology 'heteronomous hyperparasitoids' (Walter 1983). Other terms that have been used for species with this type of biology are 'autoparasites' (which I use below) and 'adelphoparasites' (Zinna 1962). Autoparasitic development is by no means rare; apart from uniparental species and a few known exceptions (Hunter et al. 1993, Mazzone 1983, Ogata 1985, Ogata 1987), male larvae of *Coccobius*, *Encarsia*, *Coccophagoides*, some *Coccophagus*, and other related genera, develop only as hyperparasites. Viggiani

(1984) provided a comprehensive review of the biology of Aphelinidae, Nikol'skaya and Yasnosh (1966) included excellent discussions of the immature development and biology of various aphelinids, and Rosen and DeBach (1979) reviewed the extensive literature on the biology and ecology of *Aphytis*.

Among Chalcidoidea, Aphelinidae are rivalled only by Encyrtidae in the number of species that have been established for biological control purposes or the number of pests that have been successfully controlled (Greathead 1986). Species of *Aphytis* have been by far the most effective natural enemies of Diaspididae (Greathead 1989, Rosen and DeBach 1979) and they have been responsible for many successful programs. Species of *Encarsia*, *Coccobius*, *Pteroptrix*, and *Coccophagoides* have all proven useful in biological control of Diaspididae; *Aphelinus* species continue to be utilized for biological control of Aphididae; *Cales*, *Encarsia*, and *Eretmocerus* have provided most of the important natural enemies of Aleyrodidae; and *Coccophagus* species have been involved in successful biological control of Pseudococcidae and Coccidae (Greathead 1989, Rosen and DeBach 1991, Clausen 1978). The importance of a sound species-level taxonomy to the success of biological control has been particularly well demonstrated in projects that have used Aphelinidae for the biological control of Homoptera (Rosen 1978, Rosen 1986, Rosen and DeBach 1973).

Fauna. The Aphelinidae are one of the smaller families of Chalcidoidea in terms of the number of genera and species, containing about 1120 species in about 40 genera. About 140 described species are known from the Nearctic region, but doubtless many more occur there, particularly in *Encarsia*, *Coccophagus*, and *Aphytis*.

Literature. In addition to the references cited above for individual genera, the most useful general references for identification of extralimital fauna are Nikol'skaya and Yasnosh (1966), Yasnosh (1978), and Ferrière (1965), who provided keys to the genera and species of Europe or the European part of the former USSR, and De Santis (1948) who reviewed the fauna of Argentina.

Key to genera of Aphelinidae

1 Tarsi 4-segmented 2

– Tarsi 5-segmented or only mesotarsus 4-segmented 4

2(1) Forewing narrow and parallel-sided, with setae arranged in 3 longitudinal lines (Fig. 6); foretibial spur straight, not curved or cleft, the opposing area of basitarsus without row of peg-like setae; flagellum with 3 funicle segments (the first a transverse anellus) and an unsegmented clava. *Male*: clava and third funicular segment with long setae arranged in whorls, the setae about half length of clava .... ***Cales*** Howard

Key: Viggiani and Carver (1988). **Fauna**: 1 sp., *C. noacki* Howard; world, 3 spp. **Hosts**: Aleyrodidae; *C. noacki* introduced into North America from South America for biological control of *Aleurothrixus floccosus* (Maskell) and widely established (Rose and DeBach 1994).

– Forewing either broadly rounded or parallel-sided but with evenly distributed setae; foretibial spur curved and cleft, the opposing area of basitarsus with row of peg-like setae; flagellum with more or fewer segments in funicle and clava sometimes segmented. *Male*: clava and third funicular segment without long setae arranged in whorls 3

3(2) *Female*: flagellum with 2 short funicular segments and an unsegmented clava (Fig. 10). *Male*: flagellum without funicle but with clava extremely long, at least 8 times as long as wide. *Both sexes*: forewing with linea calva (closed posteriorly) .... ***Eretmocerus*** Haldeman

Fauna: 6 described and several undescribed spp.; world, 33 described spp. **Hosts**: Aleyrodidae (for biology see Gerling et al. 1990).

– *Both sexes*: flagellum with 5 or 6 segments, all about same length (Fig. 14); forewing without linea calva .... ***Pteroptrix*** Westwood

Fauna: 3 spp.; world, 60 spp. **Hosts**: autoparasites of Diaspididae (for biology see Bar and Gerling 1971).

4(1) Forewing with parastigma projecting posteriorly into wing disc and with at least 1 long seta; postmarginal and stigmal veins well developed, both at least half as long as marginal vein (Fig. 5) .... ***Myiocnema*** Ashmead

Fauna/Hosts: 1 sp., *M. comperei* Ashmead, on Coccidae and Kermesidae; introduced from Australia and possibly established in USA (CA) for control of *Saissetia oleae* (Olivier) (see Smith and Compere 1928, Clausen 1978, and Hayat and Verma 1980).

– Forewing with parastigma not projecting posteriorly into wing disc; postmarginal vein usually absent or very short, at most one-quarter length of marginal vein, stigmal vein not more than one-quarter length of marginal vein 5

5(4) Flagellum with at most 3 funicular segments and 1-segmented clava; forewing with linea calva, though rarely poorly defined or absent (some *Centrodora* spp.) 6

– Flagellum with at least 5 segments, including a 2- or 3-segmented clava; forewing without linea calva 10

6(5) Pronotum entire; forewing with pattern of infuscated areas and corresponding dark setae; legs with dark bands and body extensively patterned with dark and light areas; mesopleuron with enlarged, convex acropleuron at least 5 times as long as mesepimeron (Fig. 1) .... ***Marietta*** Motschulsky

Key: Hayat (1986). **Fauna**: 7 described spp.; world, 19 described spp. **Hosts**: usually external hyperparasites of Diaspididae, Coccidae, Psyllidae, and other Homoptera, 1 sp. is a primary parasite of *Conchaspis angraeci* Cockerell (Conchaspididae) (Beardsley and Tsuda 1990) (for biology see Kfir and Rosen 1981).

– Pronotum divided; forewing usually hyaline; legs usually without banding and body color usually uniform, occasionally marked with light and dark areas; acropleuron occasionally enlarged, but not more than 3 times as long as mesepimeron 7

7(6) *Female*: flagellum with 1 segment in funicle; hypopygium extending to apex of metasoma, enclosing apex of ovipositor. *Male*: flagellum without funicle .... ***Marlatiella*** Howard

Key: Rosen and DeBach (1970). **Fauna**: 1 sp., *M. prima* Howard; world, 2 described spp. **Hosts**: Diaspididae (for biology see Rosen and DeBach 1970).

– *Both sexes*: flagellum with 3-segmented funicle. *Female*: hypopygium variable 8

8(7) Body elongate, metasoma longer than head and mesosoma combined; forewing with short venation, the combined length of submarginal and marginal veins less than half as long as wing (Fig. 9), and linea calva sometimes poorly defined or absent. *Female*: clava with apical projection (Fig. 11) .... ***Centrodora*** Förster

Fauna: 5 spp; world, 41 described spp. **Hosts**: primary parasites and hyperparasites of nymphs of Sternorrhyncha, and eggs of a wide range of Orthoptera, Homoptera, Hemiptera, Lepidoptera, Diptera, Coleoptera, and Hymenoptera (see references in Polaszek 1991).

– Body not elongate, metasoma shorter than head and mesosoma combined; forewing with normal venation, the combined length of submarginal and marginal veins more than half as long as wing, and linea calva well defined. *Female*: clava without apical projection 9

9(8) Propodeum at least 3 times as long as metanotum and with posteromedial margin almost always with crenulae (Fig. 3). *Female*: hypopygium not extending beyond three-quarters length of metasoma .... ***Aphytis*** Howard

Key: Rosen and DeBach (1979). **Fauna**: 18 spp.; world, 121 described spp. **Hosts**: external parasites of Diaspididae (see Rosen and DeBach 1979).

– Propodeum not more than twice as long as metanotum and without crenulae. *Female*: hypopygium extending to apex of metasoma and enclosing apex of ovipositor .... ***Aphelinus*** Dalman

Fauna: 27 described and at least 5 undescribed spp.; world, 50 spp. (for key to European species see Graham 1976). **Hosts**: Aphididae (for biology see Hamilton 1973 and Wahab 1985).

10(5) Axillae widely separated and small, not extending anteriorly beyond posteromedian margin of mesoscutum (Fig. 4); mesopleuron with acropleuron convex and expanded, with mesepisternum and mesepimeron small and displaced posteriorly and in lateral view suture between them not apparent (Fig. 2); cerci in dorsal view anterior to anteromedian margin of Mt_7, not at apex of metasoma (Fig. 12). *Female*: flagellum 5-segmented. *Male*: flagellum 6-segmented .... ***Coccobius*** Ratzeburg

Key: Hayat (1984). **Fauna**: 6 spp.; world, 60 spp. **Hosts**: autoparasites — females are internal parasites of Diaspididae, 1 known sp. with males as primary parasites (Ogata 1987, Takagi and Ogata 1990) (for biology see Williams 1972).

– Axillae extending anteriorly well past posteromedian margin of mesoscutum; mesopleuron either not expanded or expanded portion consisting of mesepimeron, in lateral view suture between mesepisternum and mesepimeron visible; cerci in dorsal view posterior to anteromedian margin of Mt$_7$, at apex of metasoma. *Both sexes*: flagellum usually 6-segmented, sometimes 5-segmented 11

11(10) Flagellum 5-segmented, the third segment of funicle anelliform or subquadrate, not more than half as long as second or fourth segment (Fig. 7); stigmal vein long, at least one-quarter and normally two-fifths length of marginal vein; marginal vein with 4–6 dorsal setae (Fig. 8) .... ***Ablerus*** Howard

Fauna: 5 spp.; world, 88 spp. **Hosts**: hyperparasites or, less commonly, primary parasites of Sternorrhyncha and Auchenorrhyncha (Homoptera), also primary parasites of eggs of Lepidoptera (see Polaszek 1991).

– Flagellum usually 6-segmented, but if 5-segmented then third segment not markedly shorter than second or fourth segment; stigmal vein short, not more than one-fifth length marginal vein; marginal vein with 10–20 dorsal setae 12

12(11) Mesoscutum with at least 20 setae and usually more (up to about 50), the setae not arranged in bilaterally symmetrical pattern; scutellum either with 6 long setae or many short setae; head with vertex densely setose, the setae not bilaterally symmetrical 13

– Mesoscutum with fewer than 20 setae arranged in bilaterally symmetrical pattern; scutellum with 4 setae (6 setae in one species of *Coccophagoides*); head with vertex having sparse setae arranged in bilaterally symmetrical pattern 14

13(12) Hypopygium with elongate median process (mucro) extending almost to apex of metasoma .... ***Lounsburyia*** Compere & Annecke

Key: Compere and Annecke (1961). **Fauna**: 1 sp., *L. trifasciata* (Compere); world, 2 spp. **Hosts**: autoparasites of Coccidae; *L. trifasciata* introduced from South America and established in USA (CA) for biological control of *Saissetia oleae* (Olivier) (see Clausen 1978).

– Hypopygium with median process not extending posteriorly beyond three-quarters length of metasoma .... ***Coccophagus*** Westwood

Key: Compere (1931), see also Hayat (1988, 1992). **Fauna**: 31 spp.; world, 191 spp. **Hosts**: diphagous parasites or autoparasites of Coccidae, Pseudococcidae and, more rarely, other Homoptera (see references in Walter 1988 and Viggiani 1984).

14(12) Submarginal vein with 4 or more setae; stigmal vein expanded and with distinctive shape (Fig. 17); scutellum with 4 or 6 setae. *Female*: flagellum spindle-shaped, with clava strongly narrowed apically (Fig. 13) .... ***Coccophagoides*** Girault

Key: Doutt (1966). **Fauna**: 5 spp.; world, 13 spp. **Hosts**: autoparasites of Diaspididae (for biology see Broodryk and Doutt 1966).

– Submarginal vein with 1 or 2 setae; stigmal vein not expanded (Fig. 16); scutellum always with 4 setae. *Female*: flagellum not spindle-shaped, with clava rounded apically (Fig. 15) .... ***Encarsia*** Förster

Fauna: about 25 spp. recorded and several more known to occur; world, over 200 spp., probably including many synonyms, but also many undescribed spp. known (for key to Oriental species see Hayat 1989). **Hosts**: autoparasites of Diaspididae and Aleyrodidae, and rarely eggs of Lepidoptera (see Polaszek 1991 and references in Walter 1983 and Viggiani 1984).

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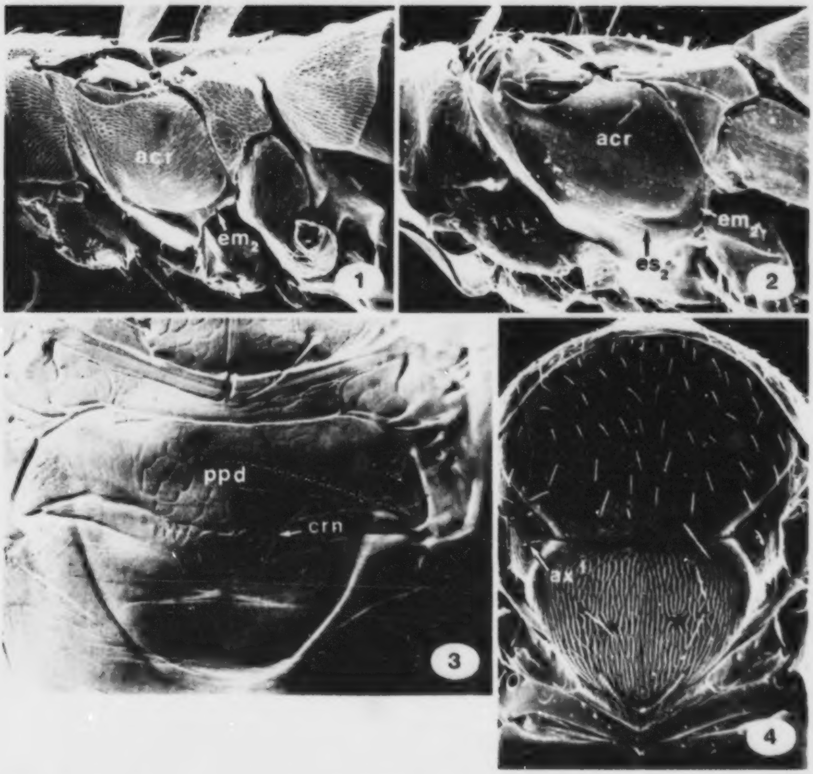
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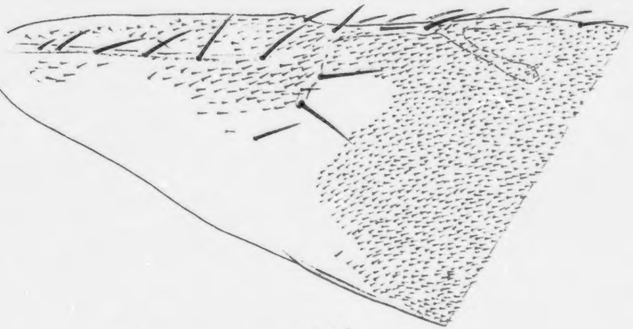
Figs. 1–4. 1–2, mesosoma: 1, ***Marietta***; 2, ***Coccobius***. 3, ***Aphytis lingnanensis*** Compere, metanotum and propodeum (abbreviation: crn = crenulae). 4, ***Coccobius***, mesosoma.



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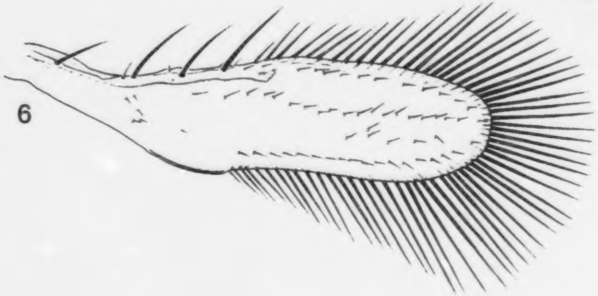

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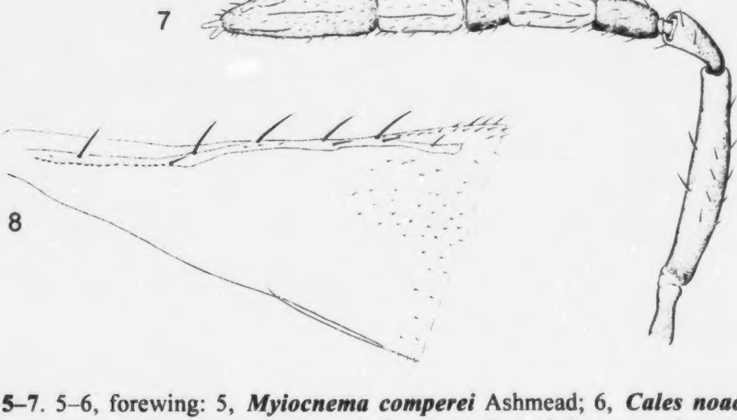

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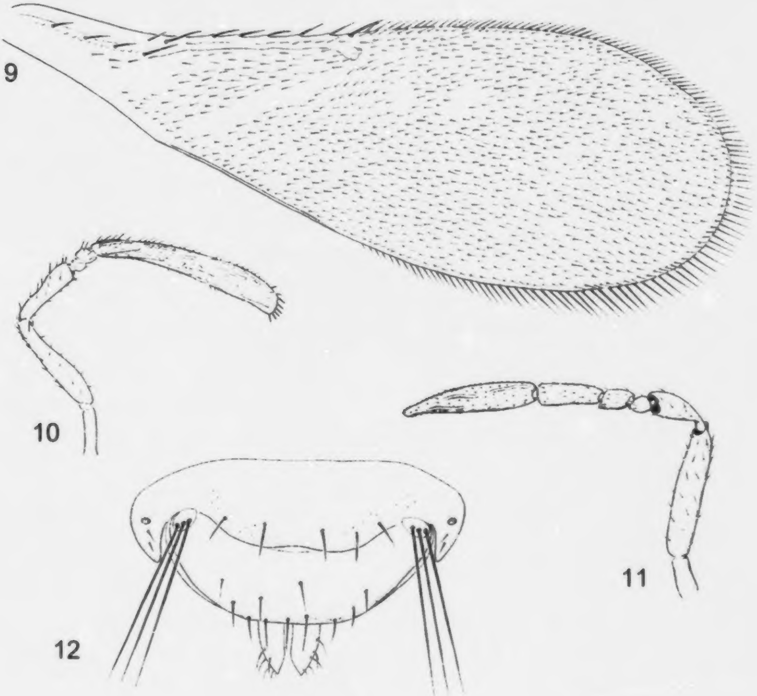
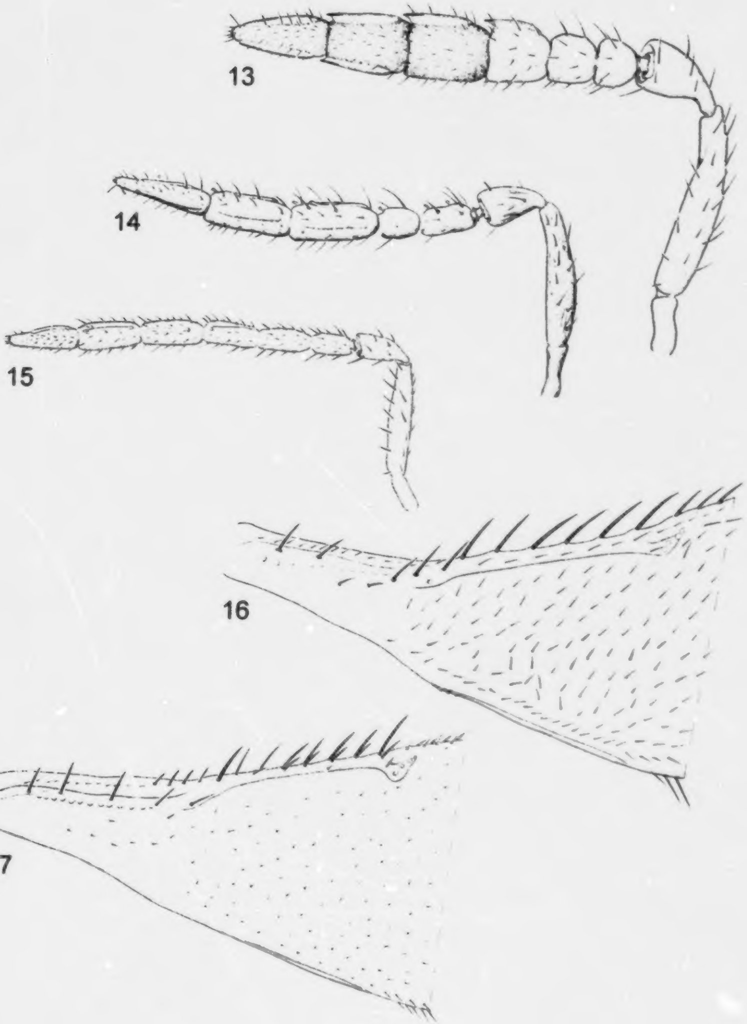
Figs. 5–7. 5–6, forewing: 5, ***Myiocnema comperei*** Ashmead; 6, ***Cales noacki*** Howard. 7, ***Ablerus clisiocampae*** (Ashmead), ♀ antenna. 8, ***A. clisiocampae***, forewing.



Figs. 9–12. 9, ***Centrodora speciosissima*** (Girault), forewing. 10–11, ♀ antenna: 10, ***Eretmocerus***; 11, ***C. speciosissima***. 12, ***Coccobius varicornis*** (Howard), apex of metasoma.



Figs. 13–17. 13–15, ♀ antenna: 13, ***Coccophagoides murtfeldtae*** (Howard); 14, ***Pteroptrix chinensis*** (Howard); 15, ***Encarsia formosa*** Gahan. 16–17, forewing: 16, ***E. formosa***; 17, ***Coccophagoides fuscipennis*** (Girault).

Chapter 6. **CHALCIDIDAE**

Zdenek Bouček and Jeffrey A. Halstead

Recognition. Most Chalcididae are easy to recognize by the following combination of features: size relatively large (length 1.5–27 mm); head and thoracic dorsum with coarse setiferous punctures; metafemur enlarged and with toothed or denticulate ventral margin; and metatibia arched. Other features include: occipital carina absent (not to be confused with genal carina); metapleuron larger than in other families; prepectus unusually small; notauli complete; propodeum usually coarsely alveolate, sometimes with distinct submedian and sublateral carinae (e.g., in Haltichellinae, Fig. 13); gaster always convex and well sclerotized, hence non-collapsing; and ovipositor sheaths not protruding [except *Acanthochalcis* (Fig. 29) with long tail formed by ovipositor and its stiff sheaths].

Some members of several other families such as Pteromalidae, Torymidae, Agaonidae and Eulophidae have the metafemora enlarged, but they lack coarse setiferous punctures and the gaster is relatively weakly sclerotized and often collapsed, or the head (in Torymidae) has a distinct occipital carina.

Systematics. The family Chalcididae has been traditionally understood with the present limits for at least 150 years, except that Leucospidae were sometimes included. Chalcididae are similar to Leucospidae in most of the features listed above but differ mainly by having the forewing flat (folding longitudinally in Leucospidae), the labrum usually exposed, the labiomaxillary complex poorly developed, the antennae usually showing a striking sexual difference, the tegula more or less broad and oval, and the apex of the scutellum often modified, but the dorsellum rather simple (Bouček 1974). Delvare (1988) discussed morphological features important to the classification of Chalcidini.

The subdivision of Chalcididae into subfamilies has also varied little, though recently the Brachymeriinae was reduced to a tribe within Chalcidinae (Bouček 1988).

Biology. Most Chalcididae are primary parasites of Lepidoptera; less numerous are species that parasitize Coleoptera (in particular Chrysomelidae and families of wood-boring Coleoptera), still fewer parasitize Diptera, Hymenoptera and Neuroptera. Species of some genera develop as secondary parasites of Lepidoptera, mostly through Braconidae, Ichneumonidae, and Tachinidae. The hosts include several economically important insect pests; however, a few beneficial insects are also parasitized. Most Chalcididae are solitary parasites, but some smaller *Conura* and *Brachymeria* are gregarious, many individuals emerging from one host pupa. Almost all Chalcididae parasitize host larvae or pupae, except some *Chalcis* that oviposit into eggs of Stratiomyidae. Adults feed on nectar and secretions of plants and insects; some *Chalcis* occasionally feed on eggs of Stratiomyidae.

Fauna. There are far fewer genera in the New World than in the Old World, but some (*Conura, Notaspidium*) have diversified into an extensive variety in the New World, especially in the Neotropical region. The Nearctic fauna includes 15 genera and about 120 species. The Neotropical fauna includes several more genera, but probably over 1000 species.

Literature. Bouček (1992) revised the genera of Chalcididae of the New World and Delvare (1992) revised the New World Chalcidini. Burks (1940) had previously revised the Chalcidini.

Use of key. All subfamilies except the extralimital Smicromorphinae (see Bouček 1988) are included in the key. The subfamily Epitraninae is also extralimital but is included in the key because *Epitranus* is sometimes intercepted at North American quarantine stations. The key includes 17 genera because the Old World genus *Antrocephalus*, which is sometimes intercepted in ports, is also added.

Key to genera of Chalcididae

1 Metatibia with apex almost perpendicularly truncate or slightly sinuate (Figs. 3, 5, 8) and with 2 apical spurs; metafemur ventrally with short or long comb of dense minute denticles mostly on lobes (Figs. 5, 8) .... HALTICHELLINAE, 2

– Metatibia ending with a broadly subtriangular or elongate, stout, sometimes blunt spine (Figs. 29, 32, 33) produced well beyond tarsal insertion and with only 1, sometimes rudimentary, apical spur; metafemur ventrally either with long comb of denticles or with spaced, small or large teeth (Figs. 38, 42, 43) 8

2(1) Marginal vein more or less on very margin of forewing (Figs. 2, 7) and postmarginal vein present although sometimes very short and stub-like (Fig. 7); mesosoma mostly dull with interspaces of punctures often narrow (Fig. 1) and almost always reticulate; flagellum usually with short setae .... Haltichellini, 3

– Marginal vein short and distinctly separated from anterior margin of forewing (Figs. 11, 12, 15) and postmarginal vein absent; mesosoma often with broad and shiny interspaces (Fig. 13), rarely densely punctured and dull; flagellum usually bare (Fig. 14), but in male rarely slightly setose (Fig. 17) .... Hybothoracini, 6

3(2) Scutellum posteriorly with short tubercle (Fig. 1); postmarginal vein longer than marginal vein and stigmal vein with distinct uncus (Fig. 2); metatibia without additional external carina; metafemur with large triangular tooth at base of comb (Fig. 3) .... ***Belaspidia*** Masi

Fauna: 1 sp., *B. longicauda* Halstead (1988), in USA (CA). **Hosts**: unknown, but European species parasitize Psychidae.

– Scutellum with apex rounded, subtruncate, or bilobed; postmarginal vein shorter than marginal vein and stigmal vein without distinct uncus (Fig. 7); metatibia with or without additional external carina; metafemur with teeth and comb variable 4

4(3) Gaster anteriorly with transverse carinate crest and with some longitudinal carinae attached to crest (Fig. 6); head without preorbital carina or carina very weak; pronotum dorsally rounded; Gt$_1$ and Gt$_2$ sometimes partly fused; scutellum posteriorly rounded, subtruncate, or with 2 short lobes; metatibia with additional carina (Fig. 5) .... ***Haltichella*** Spinola

Key: Halstead (1990*a*). **Fauna**: 5 spp., in southern Canada and USA. **Hosts**: primary or secondary parasites of small Lepidoptera.

– Gaster anteriorly evenly convex, without strong transverse crest; other characters also partly different 5

5(4) Head with scrobal depression large and deep, delimited laterally by strong preorbital carinae continued dorsally as arch between anterior and posterior ocelli (Fig. 4); pronotum with anterolateral carina ascending to dorsal surface and there ending as tubercle close to median line; metatibia without additional external carina .... ***Antrocephalus*** Kirby

Fauna: Old World genus with 1 extralimital sp., *A. mitys* (Walker), sometimes intercepted in New World ports. **Hosts**: small Lepidoptera in grain stores.

– Head with scrobal depression smaller and shallow, not reaching anterior ocellus and preorbital carina absent or weak; pronotum with anterolateral carina not ascending to dorsal surface, the dorsomedian surface rounded (Fig. 9); metafemur mostly with 2 denticulate lobes, metatibia with or without (Fig. 8) additional carina .... ***Hockeria*** Walker

Key: Halstead (1990*b*). **Fauna**: 9 spp., in southern Canada and USA. **Hosts**: mainly pupae of Lepidoptera such as Zygaenidae, Tortricidae, and Coleophoridae, but 2 spp. on Myrmeleonidae and Ascalaphidae and 1 sp. in cocoons of Diprionidae.

6(2) Gt$_1$ dorsally more or less flattened and with at least some longitudinal carinae (Figs. 18–20) anteriorly united by transverse elevation or carina, the tergum mostly with angulate corners laterally; scutellum posteriorly produced into angulate horn or spine (Figs. 18, 20); body with metallic, usually vivid sheen; metafemur with triangular tooth at beginning of comb near middle of femur placed outside of tibia when tibia adpressed to femur (Fig. 18) .... ***Notaspidium*** Dalla Torre

Fauna: 3 spp. in USA and at least 5 spp. in Mexico (see Halstead 1991; a mainly Neotropical genus with at least 35, mostly undescribed, spp.). **Hosts**: primary parasites of small Lepidoptera (in cocoons) and possibly Scolytidae, rarely secondary parasites through *Apanteles* s. l. (Braconidae).

– Gt$_1$ convex, without anterior elevation (Fig. 13) and without carinae or evident lateral corners; scutellum posteriorly rounded and always low; body black, rarely with metallic tinge; metafemur with tooth at base of comb before middle of femur placed inside of tibia when tibia adpressed to femur 7

7(6) Mesothorax ventrally with transverse carina delimiting anterior area for reception of procoxae; Gt$_1$ with posterior margin arcuate; clypeus with dorsal margin sometimes produced (Fig. 10). *Male*: clypeus without projections; antenna usually normal, the flagellum always with first segment anelliform .... ***Psilochalcis*** Kieffer

Key: Grissell and Schauff (1981). **Fauna**: 3 described and at least 10 undescribed spp., in Canada (ON, PQ) and USA. **Hosts**: Pyralidae and Gelechiidae.

– Mesothorax ventrally gradually ascending anteriorly from mesocoxa, without transverse carina; Gt$_1$ with posterior margin almost straight (Fig. 13). *Male*: clypeus with 2 narrow projections (Fig. 16); antenna with pedicel and first flagellar segment enlarged and strongly deformed (Fig. 17) .... ***Schwarzella*** Ashmead

Fauna: 1 sp., *S. arizonensis* Ashmead, in arid areas of southwestern USA and Mexico (see Bouček 1984).

8(1) Head with upper face produced into 2 strong, edged horns (Fig. 22); marginal vein unusually long but postmarginal and stigmal veins rudimentary (Fig. 23); petiole with longitudinal ridges; Gt$_1$ anteriorly striate (Fig. 21); metafemur ventrally with smoothly arched comb of minute teeth .... DIRHININAE, ***Dirhinus*** Dalman

Key: Burks (1947). **Fauna**: 3 spp. in USA (north to south of Great Lakes). **Hosts**: puparia of various Diptera.

– Head without horns on upper face; venation, petiole, Gt$_1$, and metafemur different 9

9(8) Head with toruli close to mouth on base of protruding clypeal shelf; marginal vein very long but postmarginal vein absent and stigmal vein very short (Fig. 24); petiole long, slender and striate, and gaster compressed and bulging ventrally .... EPITRANINAE, ***Epitranus*** Walker

Fauna: Old World genus with 1 extralimital sp., *E. castaneus* Cresson, described from Cuba; occasionally found in New World ports [see Bouček (1982) for revision of Oriental species]. **Hosts**: Pyralidae and Tineidae.

– Head with toruli above level of mouth corners, without clypeal shelf; marginal vein shorter and postmarginal vein always distinctly developed; petiole, if long, not striate and gaster different .... CHALCIDINAE, 10

10(9) Postmarginal vein about as long as stigmal vein (Fig. 27); malar space with coarse punctures but without trace of malar line (sulcus or carina); gaster sessile .... Phasgonophorini, 11

– Postmarginal vein evidently longer than stigmal vein; malar space with distinct malar carina, groove, or narrow strip or, if rarely indistinct and very finely sculptured, gaster on short petiole 13

11(10) Torulus distinctly above lower margin of eye; pronotum and mesonotum with interstices of punctures low, not rasp-like; scutellum with apical carina medially produced; Gt_1 dorsally shorter than Gt_2 (Fig. 28). *Female*: gaster with last tergum slightly bent and apex of ovipositor abruptly downturned .... ***Stypiura*** Kirby

Fauna: 1 sp., *S. dentipes* (Fabricius), in USA (TX) and Mexico [see Steffan (1973) for key to Neotropical spp., and Bouček and Delvare (1992) for species synonymy]. **Hosts**: probably wood-boring Coleoptera.

– Torulus at lower margin of eye; pronotum and mesonotum with rasp-like sculpture (Fig. 25); scutellum with apical carina not produced; Gt_1 dorsally longer than Gt_2. *Female*: gaster with last tergum and ovipositor straight (Figs. 25, 26) 12

12(11) Gt_1 anteriorly convex (Fig. 26) and dorsally smooth or sculptured ... . ***Trigonura*** Sichel

Key: Burks (1959). **Fauna**: at least 8 spp., in southern Canada and USA. **Hosts**: wood-boring Coleoptera such as Buprestidae, Curculionidae and Scolytidae.

– Gt_1 anteriorly with strong and sharp transverse crest followed by longitudinal carinae (Fig. 25) .... ***Phasgonophora*** Westwood

Fauna: 1 sp., *P. sulcata* Westwood, in southern Canada and USA. **Hosts**: wood-boring Buprestidae.

13(10) Gaster sessile, the petiole in dorsal view either concealed or visible as transverse line; propodeum with spiracle mostly diagonal (Fig. 30); metacoxa less than 1.3 times as long as greatest (diagonal) length of metapleuron (Fig. 31) 14

– Gaster distinctly petiolate, the petiole slightly transverse to very long (Figs. 35, 40, 42); propodeum with spiracle subvertical or nearly longitudinal; metacoxa at least 1.5 times as long as greatest length of metapleuron .... Chalcidini, 15

14(13) Body large, sometimes up to 27 mm in length; postmarginal vein much longer than marginal vein; propodeum medially vertical and laterally with triangular horizontal shelf. *Female*: gaster with terga 2–4 very short, mostly concealed under large Gt_1, and with long, protruding, stiff ovipositor sheaths (Fig. 29) .... Cratocentrini, ***Acanthochalcis*** Cameron

Keys: Halstead (1990*c*) and Bouček (1992) [see Steffan (1959) for revision of world Cratocentrini]. **Fauna**: 2 spp., in southwestern USA north to KS, and northern Mexico. **Hosts**: wood-boring Coleoptera, mainly Buprestidae.

– Body small to medium in length; postmarginal vein much shorter than marginal vein (Fig. 31); propodeum without sublateral shelf. *Female*: gaster with all terga visible and ovipositor not protruding .... Brachymeriini, ***Brachymeria*** Westwood

Key: Burks (1960). **Fauna**: 25 spp., including 2 or 3 introduced spp. [see Bouček (1992) for comments on species groups]. **Hosts**: mostly primary parasites of Lepidoptera, Diptera, and Hymenoptera, but several spp. are secondary parasites of Orthoptera and Lepidoptera through Tachinidae and Sarcophagidae.

15(13) Mesotibia with apical spur absent or, if present, spur much shorter than breadth of tibial apex (Fig. 39); mesocoxa with outer side densely setose, even above trochanteral emargination. *Female*: hypopygium reaching or even exceeding last tergum, its apex in lateral view acute-angular or narrowly produced (Figs. 37, 38). *Male*: last sternum concave and apical margin more or less emarginate .... ***Chalcis*** Fabricius

Key: Burks (1940) [see Burks (1977) for key to Mexican spp. and Delvare (1992) for supraspecific taxonomy]. **Fauna**: 9 spp., 4 of which reach southern Canada. **Hosts**: Stratiomyidae.

– Mesotibia with spur well developed, in most species about as long as breadth of tibial apex; mesocoxa with outer side either bare above trochanteral emargination or with only few bristles (Fig. 34). *Female*: hypopygium in most species not reaching apex of gaster (Fig. 36). *Male*: last sternum convex and not emarginate apically 16

16(15) Pronotum dorsally rounded, only lateral panel anteriorly carinate; scutellum with apex rounded or subangulate, without sharp carina (Fig. 35); mandibles each with 2 teeth or one mandible with 3 teeth, and each mandible with straight lower edge and upper tooth often longer than lower tooth; metafemur in most species with distinct basal inner tooth (Fig. 33) and with at least 10 small teeth along ventral margin. *Female*: hypopygium almost reaching apex of gaster, the apex in ventral view densely setose except for narrow bare median line (Figs. 35, 36) and in lateral view apex forming angle less that 90°; gaster short. *Male*: petiole at least 3 times as long as broad, yellow or whitish .... ***Melanosmicra*** Ashmead

Key: Delvare (1992 — to species groups). **Fauna**: 2 spp., in southwestern USA and in Mexico.

– Features at least partly different. *Female*: hypopygium hardly ever produced to apex of gaster (Figs. 40–42), the apex in ventral view not densely setose and often emarginate and in lateral view forming angle of about 90° or more; gaster short or long (Figs. 40, 41). *Male*: petiole variable ....***Conura*** Spinola

Keys: Burks (1940) and Delvare (1992 — *side* group only). **Fauna**: at least 45 spp. **Hosts**: mainly cocoons of Lepidoptera, but some spp. are on Coleoptera, Hymenoptera, and occasionally other insects; some spp. are secondary parasites through Braconidae and Ichneumonidae.

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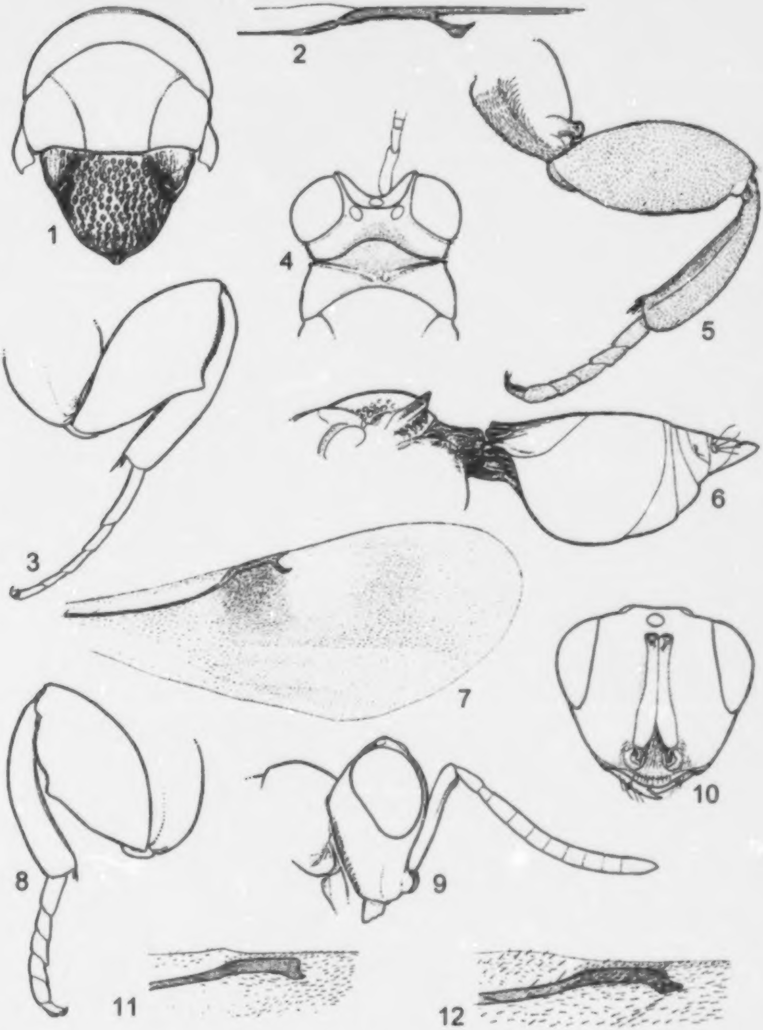

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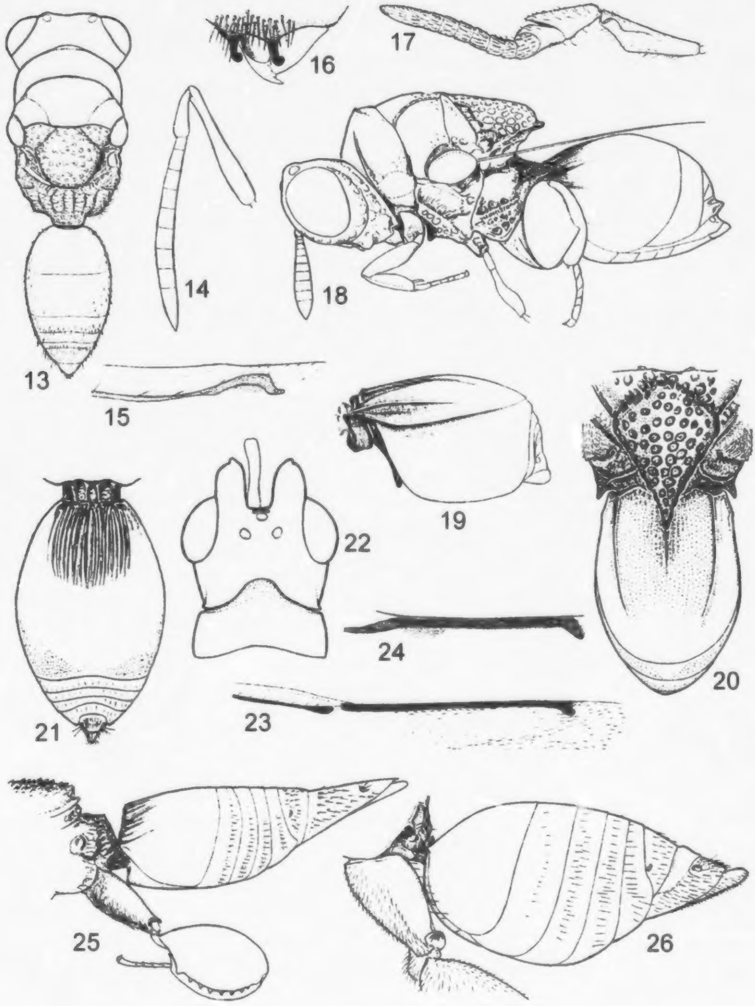

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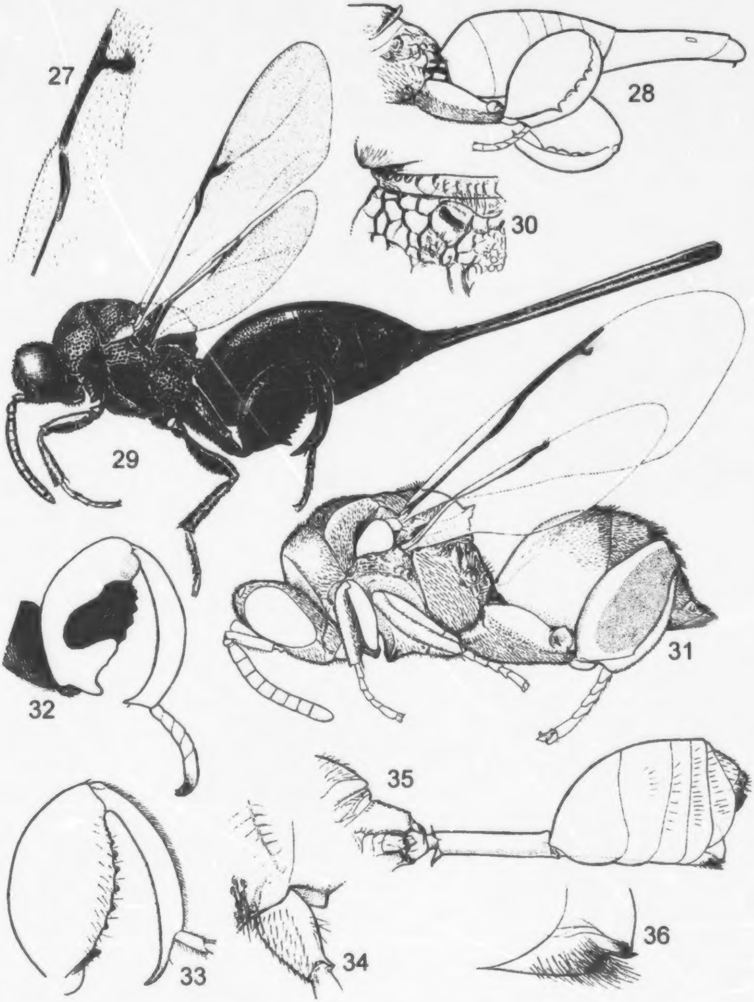

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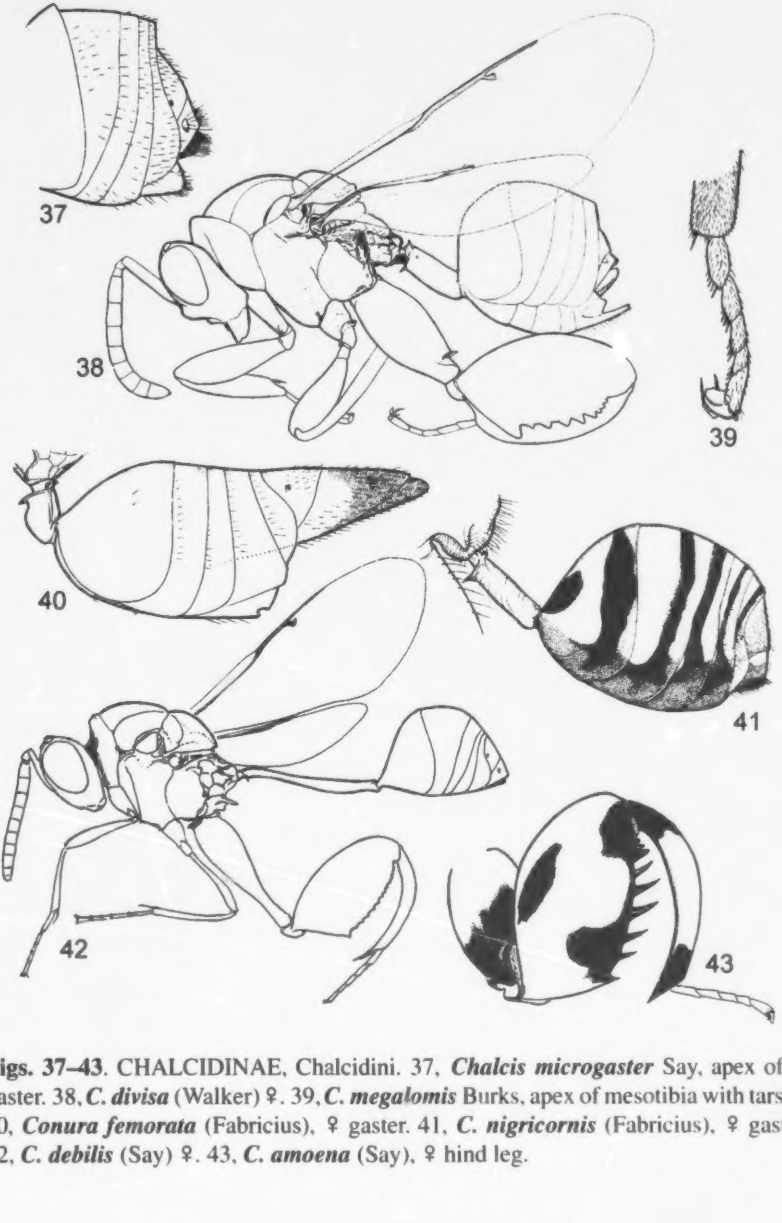

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Chapter 7. **ELASMIDAE**

Lonny D. Coote

Recognition. Elasmidae contains one genus, *Elasmus* Westwood. Monophyly of the family is supported by the following two features: metanotum with hyaline, triangular, dorsellar lamella projecting posteriorly over propodeum (Figs. 1, 2, 5), the lamella with a partial or complete medioventral keel (Figs. 6, 7) and sometimes paired, partial or complete lateroventral keels (Fig. 6); metatibia with elongate (Fig. 4) or diamond-shaped (Figs. 3, 5) patterns formed by flattened, spine-like setae usually arranged in one continuous line looping back on itself to form apparently closed cells.

In addition, elasmids have the propodeum emarginate posterolaterally (Fig. 1) to accommodate the expanded and compressed metacoxa (Figs. 1, 2, 5). Other features useful to distinguish elasmids include: forewing densely setose and wedge-shaped, with elongate marginal vein, short postmarginal vein, and reduced stigmal vein (Fig. 5); female funicle 3-segmented; male funicle 4-segmented with the 3 basal funicular segments each having dorsal branch; tarsi 4-segmented; protibial spur short and straight; metasoma subsessile; and gaster triangular in cross-section. Adults are less than 4 mm long, black or brown with varicolored metallic sheen and some small yellow areas, to mostly yellow.

Systematics. Elasmidae are closely related to Eulophidae, with the Eulophinae as the most probable sister group. Elasmids have sometimes been placed as a subfamily in the Eulophidae (e.g., Burks 1979, Yoshimoto 1984). Some classifications (e.g., Peck et al. 1964) have also included in Elasmidae at least one genus (e.g., *Euryischia* Riley) that in other classifications are included in the Eriaporinae of the Aphelinidae (Ghesquière 1955). Although the metacoxa is similar to that of *Elasmus*, *Euryischia* has a rounded dorsellar lamella without ventral keels and the metatibia has a single undulating line of setae. These differences — and other significant differences in structure and biology — argue against a close relationship between *Elasmus* and the Eriaporinae and suggest that the structural similarities are the result of convergence (Compere 1947, Ferrière 1947).

Biology. Few detailed life history studies of Nearctic species of *Elasmus* exist (e.g., Reed and Vinson 1979, Miller et al. 1987), but there are host records for about one-third of the species. Larvae of most species of *Elasmus* are gregarious, primary ectoparasites of the larvae or prepupae of leaf-mining, leaf-rolling, web-spinning, and case-making Lepidoptera; a few species are hyperparasites of cocooned prepupae of Braconidae and Ichneumonidae that parasitize the above Lepidoptera; and one Nearctic species is a primary ectoparasite of *Polistes* (Hymenoptera: Vespidae) (Burks 1971, Reed and Vinson 1979). One species has also been recorded from Tephritidae and a "midge" (Diptera) (Cushman 1927, Schwitzgebel and Wilbur 1943), but these records are questionable.

Fauna/Literature. *Elasmus* is cosmopolitan, with over 200 species recognized worldwide (Noyes 1990). About half of the species are found in the Oriental and Australasian regions. The Nearctic region has about 27 species, of which about 12 also occur in the Neotropical region and about 15 are endemic. Most of the species occurring in both regions are undescribed, as are some of the endemic species. Burks (1965, 1971, 1979) provided a key to 15 North American species, described one other species, and cataloged the species, respectively.

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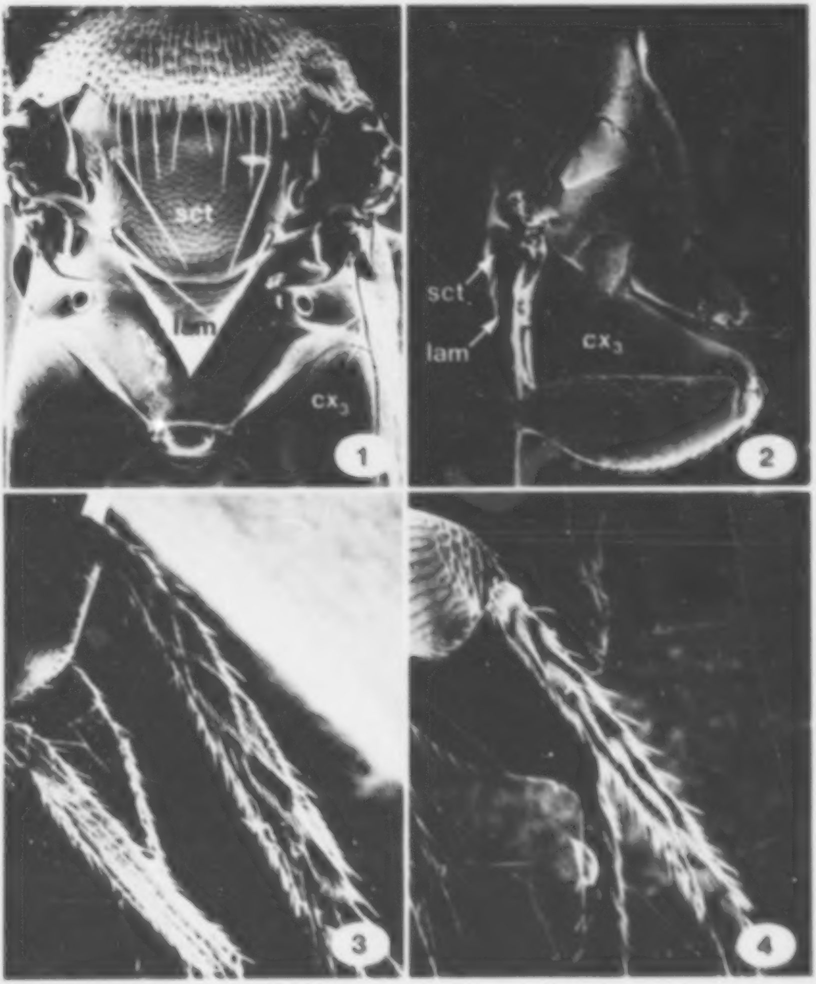
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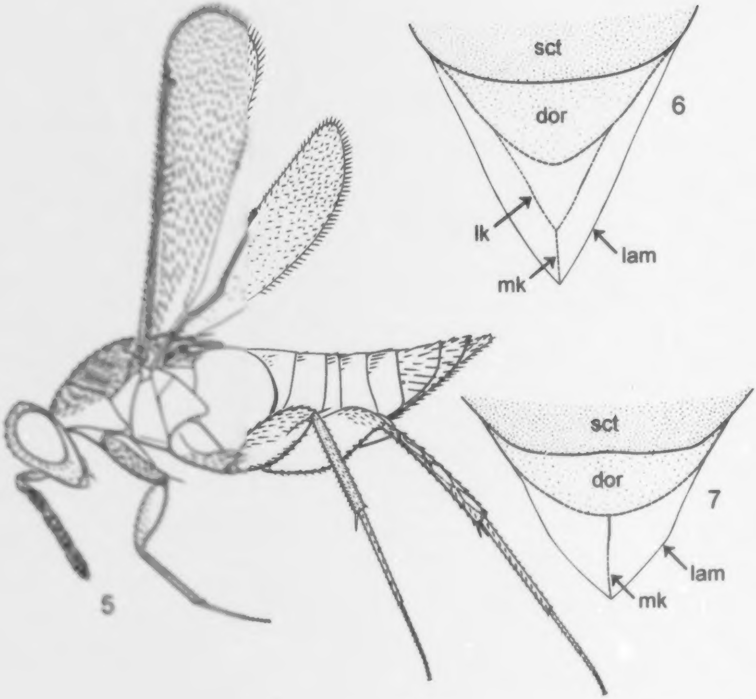
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Chapter 8. **ENCYRTIDAE**

John S. Noyes, James B. Woolley, and Gregory Zolnerowich

Recognition. Encyrtidae are among the most easily recognized of all Chalcidoidea. They are recognized by the following set of features: mesoscutum transverse and normally without notauli, but if present then notauli visible as superficially inwardly curved lines that meet at or near posterior margin of mesoscutum; mesopleuron (acropleuron) convex, undivided and in lateral view occupying more than half length of mesosoma, often touching basal segment of gaster; forewing with linea calva extending obliquely across wing from stigmal vein; mesocoxa, in lateral view, inserted at or before middle of mesopleuron; cerci usually well advanced, frequently within anterior two-thirds and often within anterior one-third of metasoma; outer plates of ovipositor separated from Mt_8, at most connected by weak membrane or elongate membranous or sclerotized strip.

Systematics. Encyrtidae can be confused with Eupelmidae and Tanaostigmatidae because all three families include species with a distinctive, enlarged, undivided mesopleuron consisting entirely of the acropleuron (Gibson 1986). However, in Eupelmidae the mesocoxal insertions are level with the posterior margin of the mesopleuron (see chapter 11), whereas in all Encyrtidae the mesocoxae are inserted level with or anterior to the midline of the mesopleuron. The Tanaostigmatidae are easily distinguished by their distinctly swollen, shoulder-like prepectus that projects anteriorly outside of the pronotum (see chapter 19). Further, Tanaostigmatidae and most Eupelmidae lack a linea calva. Other features that separate the Encyrtidae from these two families are discussed by LaSalle and Noyes (1985) and Gibson (1989). Encyrtidae can also be confused with Aphelinidae because of their generally squat habitus and small body, but most aphelinids can be distinguished from encyrtids by their well-marked notauli and relatively long marginal vein (see chapter 5). In Encyrtidae the notauli are represented by very superficial lines or are absent and the marginal vein is very short in all but a few species. In addition, the cerci are rarely advanced in aphelinids (e.g., in *Coccobius*) and are never advanced beyond the posterior quarter of the metasoma. The two families can also be separated using the position of the mesocoxae in relation to the mesopleuron, as for Eupelmidae.

Although phylogenetic relationships within Chalcidoidea are poorly understood, there seems little doubt that Tanaostigmatidae and Encyrtidae represent terminal taxa on a lineage that probably also includes Eupelmidae (LaSalle

1987, Gibson 1989). LaSalle and Noyes (1985) and LaSalle (1987) provided strong evidence for the sister group relationship of Tanaostigmatidae and Encyrtidae. Monophyly of Encyrtidae is almost certain, as indicated by their advanced mesocoxae, and advanced cerci accompanied by the separation of the outer plates of the ovipositor from Mt_8.

Trjapitzin (1973*a*, 1973*b*, 1989) discussed the different systems of classification that have been proposed for Encyrtidae and proposed the division of the family into two subfamilies, Encyrtinae and Tetracneminae. This is perhaps the most practical subfamilial division proposed to date. Tetracneminae is almost certainly a monophyletic taxon; however, there seems little doubt that the remaining taxa, representing Encyrtinae, are a paraphyletic assemblage. The monophyly of Tetracneminae is indicated by the presence of a narrow membranous or sclerotized filament (paratergite) which retains the connection of the outer plates of the ovipositor with Mt_8. In all Encyrtinae this connection is absent and the outer plates of the ovipositor are connected to the apical parts of the syntergum by a weak membrane. The subfamilies can be separated using the following diagnoses.

TETRACNEMINAE. Mandible usually bidentate with subequal teeth or with upper tooth longer, or sometimes with lower tooth almost absent, or tridentate with middle tooth longest; teeth normally acute, but occasionally distinctly rounded, never truncate; linea calva normally with marginal setae undifferentiated and more or less of equal size; filum spinosum, with few exceptions, not developed. *Female*: outer plates of ovipositor connected to Mt_8 by paratergites; syntergum varying from shield-shaped, with anterior margin more or less straight between cerci, to ∪- or ∨-shaped; hypopygium extending slightly past apex of syntergum (occasionally, if specimen has been preserved in alcohol and metasoma is distorted as a result of air-drying, the hypopygium may appear not to reach apex of syntergum); gonostyli (third valvulae), with only a few exceptions, immovably fused to second valvifers.

Trjapitzin (1973*a*) recognized 12 tribes within the subfamily, but later reduced these to 11 tribes (Trjapitzin 1989). It is impractical to recognize all of these tribes because many appear to be based on minor differences such as general habitus. Noyes and Hayat (1994) reduced the number of tribes to six and provided new characterizations for them.

ENCYRTINAE. Mandible varying from unidentate with one long sickle-shaped tooth, bidentate, tridentate or quadridentate, to unidentate or bidentate with a truncation, to broadly edentate with or without denticles; notauli varying from complete to absent; forewing normally with setae distinctly longer and thicker basal to linea calva than apical to linea calva; filum spinosum almost always present, although frequently inconspicuous. *Female*: outer plates of ovipositor not connected to Mt$_8$ via paratergites; syntergum mostly ∪- or ∨-shaped; hypopygium varying from having its apex not extending more than one-third along metasoma to extending distinctly past apex of syntergum; gonostyli, in most cases, movably articulated with the second valvifers.

Trjapitzin (1973*a*) recognized 36 tribes within the subfamily, but later reduced these to 34 tribes (Trjapitzin 1989). As with Tetracneminae, it is impractical to recognize all of these tribes because many appear to be based on minor differences. In general, genera can be placed in the correct tribe only after they have been identified.

Biology. Where biologies are known, almost all species of Encyrtidae are primary endoparasites of other arthropods or hyperparasites through other hymenopterous parasites. A few species of *Microterys* have been recorded as predators of the eggs of Coccidae (Silvestri 1919, DeBach 1939, Sugonjaev 1984, Voynovich and Sugonjaev 1989). About a third of the species are recorded from Pseudococcidae and another third from Coccidae. The remaining species are recorded from other families of Homoptera, as well as from ticks (Acari: Ixodoidea), spider eggs (Araneae), Neuroptera, Coleoptera, Lepidoptera, Orthoptera, and Diptera. Many species are hyperparasites through other Encyrtidae, Aphelinidae, Pteromalidae, Braconidae, Dryinidae, Ichneumonidae, etc. The host-parasite relations of Encyrtidae were discussed in some detail by Trjapitzin (1972, 1979) and summarized by Tachikawa (1978, 1981). Noyes and Hayat (1994) tabulated the worldwide use of Encyrtidae in biological control and listed the mealybug hosts of Encyrtidae.

The tribe Copidosomatini is of special interest because it includes species that exhibit polyembryony. In these species more than one individual can develop from a single egg. The number of individuals developing in a host may vary from fewer than 20, e.g., *Ageniaspis* species, parasites of Yponomeutidae, to more than 1000, e.g., *Copidosoma* species, parasites of Noctuidae. Strand (1989*a*, 1989*b*, 1989*c*), Baehrecke and Strand (1990), Strand et al. (1990), and Cruz (1981, 1986*a*, 1986*b*) provide good entry points to the literature on the complex developmental biology of Copidosomatini. Although they are not members of Copidosomatini (Zolnerowich 1995), species of *Epiencyrtus* are especially curious because they appear to be polyembryonic hyperparasites. One species was reared in Costa Rica from a species of *Enicospilus* (Ichneumonidae) parasitizing a caterpillar of Saturniidae. More than 1000 individual parasites were reared from the prepupa of the ichneumonid (D. Janzen, personal communication).

The degree of host specificity of Encyrtidae is not known with any certainty, but where adequate information is available it seems that many species are able to develop successfully in several different host species. For instance, *Leptomastix dactylopii* Howard (Anagyrini) has been reliably recorded from over 20 host species. In contrast, *Gyranusoidea tebygi* Noyes appears to be species-specific (Willink and Moore 1988, Narasimham and Chacko 1988), as does *Comperia merceti* (Compere) (Gordh 1973*b*). In *Copidosoma*, some species appear to be specific to a taxonomic group such as subfamily or family, e.g., *Copidosoma floridanum* (Ashmead) parasitizes almost exclusively species of Plusiinae (Noctuidae) (Noyes 1988*b*), but other species attack four or five families of Lepidoptera (Zolnerowich 1995).

Many species of Encyrtidae have been associated with successful classical biological control programs throughout the world, particularly in warmer climates. In fact, they are rivalled only by Aphelinidae in the number of reported biological control successes (Noyes 1985*a*). This is no doubt due to the preponderance of their hosts in Homoptera, because Homoptera have historically proven to be good candidates for biological control (Greathead 1989). Many Homoptera, particularly Coccoidea, are notoriously difficult to control by conventional chemical means, either because of a very high intrinsic rate of increase in population size or because the insects are protected from chemicals by a protective covering or scale. In over 90% of the biological control programs in which encyrtids have successfully controlled a pest the target has been a species of Coccoidea.

Two examples of successful biological control in the Nearctic region are given here. *Neodusmetia sangwani* (Subba Rao) was used to control Rhodesgrass mealybug, *Antonina graminis* (Maskell) (Pseudococcidae), in the southern United States. The success of this project was estimated to be worth at least $200 million per year to the Texas cattle and turf industry for an initial outlay of not more than $0.2 million (Dean et al. 1979). The mealybug is almost certainly controlled by *N. sangwani* in almost all of its range from Mexico to southern Brazil, with additional benefits to ranchers in those areas. The use of *Metaphycus helvolus* (Compere) to control *Saissetia oleae* (Olivier) (Coccidae) in California had saved the citrus industry $70 million by 1979, with an annual saving of over $2 million (van den Bosch et al. 1982). Noyes and Hayat (1994) summarized many other, mostly extralimital, examples of the use of encyrtids for biological control.

Fauna. The world fauna consists of over 3,200 described species with the greatest diversity in tropical and subtropical areas (Noyes 1989, 1990). Currently about 450 valid genera are recognized, although some authors may regard between 500 and 600 genera as valid. To date, 433 described species of Encyrtidae are known from Canada and the United States and many undescribed species are known. Noyes and Woolley (1994) recently made numerous taxonomic changes relevant to the North American fauna, including the description of several new genera from the region. We have included several genera known from the Nearctic regions of Mexico in the key and have tried to ensure that species known from Nearctic regions of Mexico will key correctly, although such biogeographic boundaries are not always clear and such decisions are often arbitrary.

Literature. The following references are useful for identification of Encyrtidae: De Santis (1964 — revision of Argentinean species), Noyes (1980 — review of Neotropical genera), Trjapitzin and Gordh (1978*a*, 1978*b* — keys to Nearctic genera), Noyes and Hayat (1984 — review of Indo-Pacific genera), Noyes (1988*a* — revision of New Zealand species), Trjapitzin (1971*c* — review of Palearctic genera), Trjapitzin (1989 — review of Palearctic species), Tachikawa (1963 — revision of Japanese species), Prinsloo and Annecke (1979 — key to Afrotropical species), Beardsley (1976 — review of Hawaiian genera and species).

Use of key. Several morphological terms used in Encyrtidae require clarification. The linea calva (Fig. 27: lc) is a bare streak on the forewing that extends obliquely from the stigmal vein posteriorly and basally almost to the posterior margin of the wing. An 'entire' linea calva (e.g., Figs. 36, 47, 65, 75, 108, 161) is devoid of any seta with their bases in the bare area. A 'closed' linea calva (e.g., Figs. 35, 41, 44, 51, 77, 96, 105) is completely or substantially terminated at the posterior/basal end by a line of setae on the dorsal surface of the wing and an 'open' linea calva (e.g., Figs. 47, 58, 75) is not. An 'interrupted' linea calva (e.g., Figs. 57, 67, 102, 138, 149, 156) has at least one dorsal seta, more often a group or line of dorsal setae, lying in the bare area at some intermediate point. The filum spinosum (Fig. 41: fsp) is a line of thickened, differentiated setae on the outer margin of the linea calva. A truncation on the mandible (e.g., Figs. 68, 104, 123, 147) is a medial surface without teeth. A truncation on the antennal clava (e.g., Figs. 25, 31, 63, 89, 117, 121, 142) refers to an apical margin that appears transversely or obliquely 'cut off' and not evenly rounded, pointed, or otherwise symmetrical. This apical truncate area typically contains numerous sensilla and is distinct from surrounding regions of the clava, visible particularly in slide mounts. In some cases the key requires comparison of the length of this oblique area with the length of the undifferentiated ventral margin of the clava. Eye length, unless specifically stated to be in frontal or facial view, refers to the longest dimension of the compound eye in lateral view.

Accurate identification of Encyrtidae requires good quality specimens. In many cases, slide-mounted specimens will facilitate observation of characters used in the key. Because of the extensive sexual dimorphism found in most Encyrtidae there is a separate key to males following the key to females. In the male key, users are referred to the appropriate couplet in the female key for annotations on each genus. In general, females have many more distinctive features than males and users may find it more difficult to make confident identifications based only on males.

Key to genera of Encyrtidae

Females (for key to males see p. 247)

1 Tarsi 4-segmented; body less than 0.75 mm 2
– Tarsi 5-segmented; body variable in length 3

2(1) Wings present; funicle with segments adpressed to clava and difficult to distinguish [forewing base, Fig. 43] .... ***Arrhenophagus*** Aurivillius

Fauna: 2 spp., *A. chionaspidis* Aurivillius, throughout region, and *A. albitibiae* Girault in USA (FL); world 2 spp. (see Annecke and Prinsloo 1974). **Hosts**: Diaspididae.

– Wings absent; funicle with 4 clearly separated segments .... ***Tetracyclos*** Kryger

Fauna: 1 sp., *T. boreios* Kryger in Canada (NT) and Greenland (Gibson and Yoshimoto 1981). **Hosts**: probably Pseudococcidae associated with *Dryas* (Rosaceae).

3(1) Funicle at most 5-segmented 4
– Funicle at least 6-segmented 31

4(3) Funicle 3- or 4-segmented 5
– Funicle 5-segmented (first funicular segment sometimes minute, transverse, and closely appressed to second segment) 11

5(4) Clava 1-segmented; submarginal vein the only distinct vein present, marginal, stigmal, and postmarginal veins indistinct (e.g., Fig. 43); frontovertex with transverse membranous line intersected by vertical membranous lines from toruli; body shorter than 0.75 mm .... ***Arrhenophagoidea*** Girault

Key: Annecke and Prinsloo (1974). **Fauna**: 1 sp., *A. coloripes* Girault, in USA (FL); world, 4 spp. **Hosts**: Diaspididae.

– Clava 3-segmented; wing veins distinct; face without membranous lines; body longer than 0.75 mm 6

6(5) Head with frontofacial ridge (Fig. 49); clava with apex obliquely truncate; scutellum smooth and without sculpture .... ***Brachyplatycerus*** De Santis

Fauna: 1 unidentified sp. in USA (NC); world, 1 described species (see De Santis 1972).

– Head without frontofacial ridge; clava with apex rounded; scutellum with some sculpture 7

7(6) Hypopygium extending to apex of metasoma; body robust; face in lateral view rounded; scutellum apically without large lamelliform setae; occipital margin without enlarged setae [antenna, Fig. 60; forewing base, Fig. 61] .... ***Cercobelus*** Haliday

Fauna: at least 2 undescribed spp., in USA and highland Mexico (Guerrero); world, 1 described sp. **Hosts**: extralimital sp. on nymphs of Psyllidae (see Trjapitzin 1989).

– Hypopygium extending at most one-half length of metasoma; body dorsoventrally flattened; head in lateral view wedge-shaped, acutely angled between antennal scrobes and frontovertex; scutellum apically usually with slightly to strongly broadened and flattened lamelliform setae (e.g., Fig. 103); occipital margin often with 2 enlarged setae 8

8(7) Forewing hyaline .... ***Plagiomerus*** Crawford

Key: Beardsley (1976). **Fauna**: 2 spp., *P. cyaneus* (Ashmead) and *P. diaspidis* Crawford (possibly synonymous), in USA (DC, FL, NM); world, 6 described spp. **Hosts**: Diaspididae (see Gordh and Lacey 1976).

– Forewing with infuscate pattern 9

9(8) Funicle with all segments longer than broad .... ***Homalopoda*** Howard

Fauna: 1 undescribed sp. in USA (FL, SC); world, 1 described sp. (see Noyes 1979). **Hosts**: probably Diaspididae.

– Funicle with all segments quadrate or transverse 10

10(9) Pronotum with posterior margin nearly straight or slightly recurved, at midline one-half length of mesoscutum .... ***Caenohomalopoda*** Tachikawa

Key: Tachikawa et al. (1979). **Fauna/Hosts**: 1 sp., *C. shikokuensis* (Tachikawa), reared from Diaspididae on bamboo in USA (FL) (Bennett and Noyes 1989); world, 4 described spp.

– Pronotum with posterior margin broadly ∨–shaped, medially incised and at most one-quarter length of mesoscutum .... ***Pseudhomalopoda*** Girault

Fauna: 1 sp., *P. prima* Girault, in USA (FL, TX) (see Tachikawa 1979). **Hosts**: Diaspididae; *P. prima* used in control of *Aonidiella aurantii (*Maskell) (see Muma et al. 1961).

11(4) Wings shortened or absent 12

– Wings fully developed and reaching apex of metasoma 15

12(11) Funicle apparently 4-segmented, first funicular segment transverse and minute, closely appressed to second segment which is longer than broad, third to fifth funicular segments subquadrate to longer than broad; mesotibial spur flattened, spatulate (Fig. 9) .... ***Meromyzobia*** Ashmead (part)

Key: Gordh (1987). **Fauna**: 10 described spp., throughout region; world, 14 described spp. **Hosts**: parasites of eggs of Orthoptera and puparia of Chloropidae and Chamaemyiidae, generally associated with grasses (Gordh 1987, Noyes 1980).

– Funicle clearly 5-segmented, all transverse; mesotibial spur gradually tapered and pointed 13

13(12) Scutellum rectangular, with posterior margin truncate; clava 2-segmented .... ***Stemmatosteres*** Timberlake

Fauna: 2 spp., *S. apterus* Timberlake in USA (CA) and *S. kuchari* Yoshimoto in Canada (AB) (see Yoshimoto 1972); world, 4 spp. **Hosts**: Pseudococcidae associated with grasses.

– Scutellum triangular, with posterior margin acute; clava 3-segmented 14

14(13) Clava white, paler than at least some dark brown funicular segments .... ***Pseudaphycus*** Clausen (part)

Key: Gahan (1946). **Fauna**: 13 described and several unidentified spp., throughout region; world, about 25 described spp. **Hosts**: Pseudococcidae; several *Pseudaphycus* spp. used in biological control, e.g. *P. mundus* Gahan and *P. utilis* Timberlake (Clausen 1978).

– Clava yellow, concolorous with funicle .... ***Acerophagus*** Smith (part)

Key: Rosen (1969). **Fauna**: 10 described spp., throughout region; world, 16 described spp. **Hosts**: Pseudococcidae.

15(11) Scape expanded, only 2 times as long as broad, with dorsal edge curved to form channel for clava; clava in lateral view expanded and triangular, wider and much longer than funicular segments (Fig. 171); head with frontofacial ridge; stigmal vein strongly curved towards apex of wing .... ***Tropidophryne*** Compere

Key: Prinsloo and Annecke (1978). **Fauna/Hosts**: 1 sp., *T. melvillei* Compere, released in USA (CA) to control *Pseudococcus maritimus* (Ehrhorn), but probably not established (Clausen 1978); world, 5 described spp. (all Afrotropical).

– Scape at least 3 times as long as broad, with dorsal edge not curved to form channel for clava; clava in lateral view longer than broad, subequal in length or not greatly exceeding width of sixth funicular segment; head without frontofacial ridge; stigmal vein straight 16

16(15) Postmarginal vein longer than stigmal vein; mesoscutum and scutellum with fine, longitudinally striate sculpture .... ***Holcothorax*** Mayr

Key: Askew (1983). **Fauna/Hosts**: 1 described sp., *H. testaceipes* (Ratzeburg), introduced into Canada and USA to control *Phyllonorycter crataegella* (Clemens) and *P. blancardella* (Fabricius) (Gracillariidae) (Maier 1993, Wang and Laing 1989); world, 2 described spp.

– Postmarginal vein not longer than stigmal vein; sculpture of mesoscutum and scutellum different 17

17(16) Clava 1- or 2-segmented 18

– Clava 3-segmented 21

18(17) Clava longer than funicle (Fig. 174); eye shorter than malar space; body dark brown .... ***Zaommoencyrtus*** Girault (part)

Fauna: 1 described sp., *Z. submicans* Girault, and at least 2 undescribed spp.; world, 5 described spp. (see Girault 1916*a*). **Hosts**: immature stages of Tenebrionidae, associated with dead wood.

– Clava shorter than funicle or, if longer, eye clearly longer than malar space; body varying in color, from orange to dark brown or black 19

19(18) Ovipositor exserted one-fifth length of metasoma; clava 2-segmented .... ***Pseudectroma*** Girault

Fauna: 1 described sp., *P. europaeum* (Mercet), introduced from Europe to USA (TX) in late 1950's to control *Antonina graminis* (Maskell), but apparently not established (Dean and Schuster 1958, as *Timberlakia europaea*), and 1 unidentified sp.; world, 7 described spp. (see Prinsloo 1982, as *Timberlakia*). **Hosts**: Pseudococcidae associated with grasses.

– Ovipositor not or barely exserted; clava 1-segmented 20

20(19) Clava obliquely truncate, with apex produced dorsally as short, finger-like process; forewing with diffuse infuscation around marginal and stigmal veins; body blackish .... ***Mayridia*** Mercet (part)

Fauna: 1 described sp., *M. americana* Timberlake (see Timberlake 1926), and at least 3 undescribed spp.; world, about 25 described spp. **Hosts**: Pseudococcidae.

– Clava apically rounded, without finger-like process; forewing hyaline; body orange to orange-brown .... ***Pseudorhopus*** Timberlake

Fauna: 2 described spp., *P. hartmanni* Timberlake and *P. fuscus* (Girault), and several undescribed spp., throughout North America (see Sugonjaev 1989, as *Americencyrtus*); world, 3 spp. **Hosts**: Coccidae (Timberlake 1926).

21(17) Pronotum with posterior margin medially incised or broadly v-shaped 22

– Pronotum with posterior margin nearly straight or uniformly concave 23

22(21) Head prognathous, smooth and without sculpture, and frontovertex wider than half width of head; pronotum with posterior margin broadly ∨-shaped; marginal vein longer than broad; mesoscutum with light alutaceous sculpture; scutellum smooth; hypopygium extending two-thirds length of metasoma .... ***Zaommoencyrtus*** Girault, see 18

– Head hypognathous, with distinct sculpture, and frontovertex one-fifth width of head; pronotum with posterior margin nearly straight but incised medially; marginal vein punctiform or as long as broad; mesoscutum and scutellum with deep sculpture; hypopygium extending to apex of metasoma .... ***Archinus*** Howard

Fauna: 1 unidentified sp. in USA (GA); world, 1 described sp. (see Noyes 1979). **Hosts**: unknown, but probably Pseudococcidae.

23(21) Funicle with first and second segments small and subquadrate, contrasting greatly with large, quadrate to longer than broad, third to fifth segments (Fig. 32); ovipositor exserted one-half length of metasoma .... ***Ameromyzobia*** Girault

Fauna: 1 unidentified sp. in USA (FL); world, 2 described spp. (see Girault 1916*b*, Trjapitzin 1971*b*). **Hosts**: recorded as Diaspididae on grass (Noyes 1980), but this almost certainly incorrect, more likely Pseudococcidae on grasses.

– Funicle different; ovipositor, if exserted, much less than one-half length of metasoma 24

24(23) Head and dorsum of mesosoma yellow to orange or, if darker, not shiny and mesopleuron light in color 25

– Head and mesosoma dark, shiny or metallic 26

25(24) Clava white, contrasting greatly with dark brown funicle .... ***Pseudaphycus*** Clausen, see 14

– Clava yellow to orange, never white, same color as funicle .... ***Acerophagus*** Smith, see 14

26(24) Marginal vein not reaching anterior margin of wing and punctiform; postmarginal vein absent (Fig. 169) .... ***Trechnites*** Thomson

Fauna: 2 spp., *T. insidiosus* (Crawford) and *T. psyllae* (Ruschka) in USA (CA, CT, NY, OR, WA), and at least 2 unidentified spp; world, 16 described spp. **Hosts**: nymphs of Psyllidae; *T. psyllae* and an undescribed sp. were introduced into USA from Iran, Afghanistan, and various European countries for control of *Psylla pyricola* Förster (Clausen 1978, Unruh et al. 1994).

– Marginal vein reaching wing margin, the length of marginal and postmarginal veins variable 27

27(26) Metasoma at least partly white or yellow; funicle with first 4 segments clearly transverse (Fig. 48) ....
.... ***Bothriocraera*** Timberlake
Fauna/Hosts: 2 spp., *B. bicolor* Compere & Zinna (1955), released into USA (CA) to control various mealybug pests on citrus (Bartlett and Lloyd 1958), and *B. flavipes* Timberlake.

– Metasoma completely dark brown; funicle with first 4 segments sometimes clearly transverse, but usually subquadrate or longer than broad 28

28(27) Forewing with linea calva at least as wide as length of stigmal vein, and without filum spinosum (Fig. 165); mandible bidentate .....
.... ***Tetracnemoidea*** Howard
Key: Trjapitzin and Gordh (1980*a*). **Fauna**: 4 spp. including *T. brevicornis* (Girault), *T. peregrina* (Compere) and *T. sydneyensis* (Timberlake), throughout North America; world, 17 spp. **Hosts**: Pseudococcidae; species of *Tetracnemoidea* are useful in natural and biological control of various mealybug pests in USA (CA, TX) and elsewhere.

– Forewing with linea calva narrower, its width anteriorly less than length of stigmal vein, and with filum spinosum (e.g., Fig. 79); mandible tridentate 29

29(28) Clava apically rounded, with sensory area only at extreme apex; stigmal vein with uncus (e.g., Figs. 69, 70) ....
.... ***Arhopoidiella*** Noyes
Fauna: 1 undescribed sp. in USA (MD, MO, SC, TX, VA) (see Noyes 1980).

– Clava either with oblique apical truncation or sensory area extending at least half length of clava; stigmal vein without uncus, its apex truncate (e.g., Fig. 79) 30

30(29) Clava with apex rounded or pointed; forewing weakly infuscate behind marginal and stigmal veins; propodeal spiracle rounded, not reaching anterior margin of propodeum (Fig. 12); procoxa and metacoxa white .... ***Copidosoma*** Ratzeburg (part)
Fauna: 13 described and about 30 undescribed spp., throughout region; world, about 150 described spp. **Hosts**: polyembryonic parasites of larvae of Lepidoptera.

– Clava with apex obliquely truncate; forewing completely hyaline; propodeal spiracle comma- or pear-shaped, its narrow end extending to anterior margin of propodeum (Fig. 11); procoxa and metacoxa dark brown .... ***Copidosomopsis*** Girault

Key: Caltagirone (1985). **Fauna**: 2 described and 2 undescribed spp.; world, 7 described spp. (see Trjapitzin et al. 1987). **Hosts**: polyembryonic parasites of larvae of Pyralidae and Tortricidae; *C. plethoricus* (Caltagirone) introduced into USA (CA) to control *Amyelois transitella* (Walker) (Pyralidae) (Caltagirone et al. 1964).

31(3) Forewing shortened, not extending to apex of metasoma 32

– Forewing not shortened or, if slightly reduced, extending to apex of metasoma 85

32(31) Torulus closer to anterior ocellus than to mouth [habitus, winged female, Fig. 109] .... ***Hexacladia*** Ashmead (part)

Key: Burks (1972). **Fauna**: 3 described spp., *H. hilaris* Burks, *H. koebeli* (Perkins), and *H. smithi* Ashmead, and 1 undescribed sp.; world, 8 described spp. **Hosts**: gregarious parasites of adults of Scutelleridae and Pentatomidae, the parasites pupate inside the living host (Rasplus et al. 1990).

– Torulus closer to mouth margin than to anterior ocellus 33

33(32) Hypopygium not extending more than about three-quarters length of metasoma 34

– Hypopygium extending to apex of metasoma, or very nearly so 58

34(33) Scape not more than 2.5 times as long as broad 35

– Scape at least 3 times as long as broad 41

35(34) Funicle broad and flat (Fig. 56) 36

– Funicle cylindrical 38

36(35) Funicle narrowing apically, with sixth segment not wider than first segment; clava narrower than funicle and narrowing apically, with apex rounded (Fig. 56) .... ***Ceraptroceroideus*** Girault (part)

Key: Trjapitzin and Gordh (1979*a*). **Fauna**: 2 described and 3 undescribed spp., throughout North America. **Hosts**: unknown, but almost certainly Diaspididae.

– Funicle broadening apically, with sixth segment at least twice as wide as first segment; clava as wide as funicle and with apex obliquely truncate 37

37(36) Scutellum shiny with shallow reticulate sculpture; forewing rudiment with dark fascia .... ***Cerapterocerus*** Westwood (part)

Key: Gordh and Trjapitzin (1981). **Fauna**: 1 described sp., *C. phragmitis* Gordh & Trjapitzin, and at least 3 unidentified spp., throughout region. **Hosts**: hyperparasites of Coccidae through other Encyrtidae.

– Scutellum deeply rugose, not shiny; forewing rudiment evenly suffused with pale infuscation .... ***Anicetus*** Howard (part)

Key: Annecke (1967). **Fauna**: 2 described and at least 1 unidentified sp. **Hosts**: Coccidae.

38(35) Scutellum with apical tuft of setae (Fig. 64); mesoscutum anteriorly orange with posterior third metallic green or blue .... ***Diversinervus*** Silvestri (part)

Key: Rosen and Alon (1983). **Fauna**: 3 spp., *D. cervantesi* (Girault), *D. elegans* Silvestri, and *D. smithi* Compere, in USA (CA, FL); world, 11 described spp. **Hosts**: Coccidae; *D. smithi* was released into USA (CA) to control *Saissetia oleae* (Olivier).

– Scutellum without apical tuft of setae; mesoscutum colored differently, either completely shiny or completely matt 39

39(38) Mesosoma and metasoma dorsally matt, without metallic reflections; flagellum with at least some segments white .... ***Metaphycus*** Mercet (part)

Keys: Timberlake (1916) (as *Aphycus* in part), Gordh and Trjapitzin (1981) (as *Erythraphycus*). **Fauna**: at least 35 described and many unidentified spp., throughout North America; world, over 200 described spp. **Hosts**: Eriococcidae, Coccidae, Diaspididae, Kerriidae and Asterolecaniidae; also recorded from galls of Psyllidae, but here probably parasites of scale insects inhabiting the galls.

– Mesosoma and metasoma dorsally shiny with metallic green reflections; flagellum brown 40

40(39) Forewing rudiment not extending past apex of scutellum; scutellum truncate; axillae widely separated (Fig. 152) .... ***Pulexencyrtus*** Noyes & Woolley

Fauna: 1 described sp., *P. medusa* Noyes & Woolley (1994) in USA (FL).

– Forewing rudiment extending well past apex of scutellum; scutellum more or less acute, pointed; axillae meeting medially .... ***Aschitus*** Mercet

Key: Ferrière (1956). **Fauna**: 1 sp., *A. subterraneus* (Ferrière), introduced from Europe; world, 15 spp. **Hosts**: *Aclerda subterranea* Signoret (Aclerdidae).

41(34) Scutellum with apical tuft of setae (Fig. 64) .... ***Cheiloneurus*** Westwood (part)

Key: Gahan (1914) (some species). **Fauna**: 18 described spp., and at least as many undescribed spp.; world, well over 100 described spp. **Hosts**: primarily hyperparasites of scale insects (mainly Coccidae) through Encyrtidae and Aphelinidae, also hyperparasites of Dryinidae parasitic on Auchenorrhyncha and parasites of predatory Diptera associated with scale insects.

– Scutellum without apical tuft of setae 42

42(41) Mesoscutum with notauli in at least anterior third; funicle with first 2 segments anelliform and third to sixth segments longer than broad; mesotibial spur spatulate (Fig. 9) .... ***Meromyzobia*** Ashmead, see 12

– Mesoscutum without notauli; funicle different; mesotibial spur slender, gradually tapered and pointed 43

43(42) Scutellum, excluding axillae, yellow or orange, sometimes slightly darkened basally, without any metallic green sheen, except perhaps at extreme apex 44

– Scutellum completely dark brown or black with metallic green sheen (material stored for a prolonged period in alcohol may discolor and scutellum may appear to be orange, but it retains a distinct metallic green sheen) 50

44(43) Forewing rudiment white .... ***Baeocharis*** Mayr

Fauna: 1 sp., *B. pascuorum* Mayr (see Mercet 1921). **Hosts**: reared from *Eriopeltis festucae* (Fonscolombe) (Coccidae) in USA (NH).

– Forewing rudiment infuscate or hyaline 45

45(44) Funicle with segments laterally flattened, the funicle widest in middle and tapered toward each end; clava narrower than funicle .... ***Cheiloneurus*** Westwood, see 41

– Funicle with segments cylindrical or oval in cross section, the funicle not widest in middle; clava not narrower than funicle 46

46(45) Forewing rudiment with distinct dark pattern ....
.... ***Neococcidencyrtus*** Compere (part)

Key: Noyes (1987). **Fauna**: 2 spp., *N. poutiersi* (Mercet) and *N. hynodis* Noyes, in USA (CA, NC, SC, TX); world, 18 spp.

– Forewing rudiment hyaline or nearly so 47

47(46) Head black; mesoscutum usually covered with conspicuous silvery setae 48

– Head orange; mesoscutum covered with dark inconspicuous setae 49

48(47) Clava with strongly oblique apical truncation, the sensory (truncate) area more than half as long as funicle, and with oblique sutures
.... ***Echthrogonatopus*** Perkins (part)

Fauna: 1 described sp., *E. pachycephalus* Perkins (1906), and at least 2 undescribed spp.; world, 4 described spp. **Hosts**: hyperparasites of Cicadellidae through Dryinidae.

– Clava with apex more or less rounded, the sensory area at extreme apex only, and with transverse sutures ....
.... ***Neastymachus*** Girault (part)

Fauna: 2 undescribed spp. in USA (FL, TX); world, 8 described spp. (see Trjapitzin 1962). **Hosts**: Aclerdidae and Asterolecaniidae.

49(47) Clava white, contrasting with dark brown funicle (Fig. 28); occipital margin rounded [forewing, Fig. 29] ....
.... ***Aesaria*** Noyes & Woolley (part)

Fauna: 1 described sp., *A. perseus* Noyes & Woolley (1994), in USA (KS, TX), and 1 undescribed sp; Nearctic only.

– Clava brown, at least as dark as funicle; occipital margin sharply ..
.... ***Microterys*** Thomson (part)

Key: Compere (1926) (species in California). **Fauna**: 19 described and several unidentified spp.; world, about 150 described spp. **Hosts**: Coccoidea, mainly Coccidae, Kerriidae, and Eriococcidae; *M. nietneri* (Motschulsky) [= *M. flavus* (Howard)] used to control *Coccus hesperidum* L.

50(43) Clava yellowish, paler than brown funicle ....
.... ***Mayridia*** Mercet, see 20

– Clava brown, at least as dark as the darkest funicular segment ....
....51

51(50) Occipital margin acute and sharply margined .... ***Trichomasthus*** Thomson (part)

Fauna: 9 described and several unidentified spp., throughout region; world, about 50 described spp. (see Jensen and Sharkov 1989 for key to spp. of Palearctic region, including some from Nearctic; see also Sugonjaev 1989). **Hosts**: Coccidae, Eriococcidae, Pseudococcidae and Diaspididae.

– Occipital margin broadly rounded or, if conspicuously margined, not acute 52

52(51) Mesopleuron touching base of metasoma or very nearly so, in lateral view separating propodeum from metacoxa (e.g., Fig. 7) 53

– Mesopleuron clearly separated from base of metasoma by propodeum, the propodeum touching metacoxa (e.g., Fig.8) 56

53(52) Propodeum with very conspicuous dense tuft of silvery setae lateral to spiracle; ocelli very small and inconspicuous [antenna, Fig. 84; forewing, Fig. 83] .... ***Ectroma*** Westwood

Fauna: at least 2 unidentified spp. **Hosts**: unknown, but almost certainly Eriococcidae or Coccidae on grasses. (See De Santis 1972.)

– Propodeum with a few inconspicuous brown, translucent or slightly silvery setae not in distinct tuft; ocelli conspicuous 54

54(53) Torulus high on head, its dorsal margin clearly above ventral margin of eye; scutellum flat, not shiny [antenna, Fig. 74; base of forewing, Fig. 75] .... ***Comones*** Noyes & Woolley (part)

Fauna: 2 spp., *C. ferrierei* (Burks) and *C. gastron* (Walker) (see Noyes and Woolley 1994). **Hosts**: Aclerdidae associated with grasses.

– Torulus lower on head, its dorsal margin well below ventral margin of eye; scutellum convex and generally shiny 55

55(54) Axillae touching medially; mandible tridentate .... ***Helegonatopus*** Perkins (part)

Key: Szelenyi (1972). **Fauna**: 1 described sp., *H. pseudophanes* Perkins; world, 15 spp. **Hosts**: hyperparasites of Auchenorrhyncha, notably Cicadellidae, through Dryinidae.

– Axillae separated, overhung medially by posterior margin of mesoscutum (Fig. 15); mandible with 1 tooth and broad truncation (rarely with other configurations) .... ***Ooencyrtus*** Ashmead (part)

Key: Noyes (1985*b*) (some species). **Fauna**: 12 described and probably at least as many undescribed spp. (see Yoshimoto 1975, 1977); world, well over 100 described spp. **Hosts**: most spp. are parasites of eggs of insects or spiders, most commonly Lepidoptera and Hemiptera, some spp. have been reared from larvae of Lepidoptera, probably as hyperparasites through Braconidae, and others are primary parasites of larvae of Syrphidae.

56(52) Eye small, not reaching occipital margin and not longer than least width of frontovertex or hardly so .... ***Pseudencyrtus*** Ashmead (part)

Fauna: 2 described spp., *P. bolus* (Walker) and *P. cecidomyiae* (Howard), and at least 2 undescribed spp.; world, 8 described spp. **Hosts**: larvae of Cecidomyiidae and Cryptophagidae.

– Eye reaching or overreaching occipital margin and at least about 1.5 times as long as least width of frontovertex 57

57(56) Eye with posterior margin slightly convex; mandible with 1 or 2 teeth and a truncation (Fig. 68) .... ***Coccidencyrtus*** Ashmead (part)

Key: Compere and Annecke (1961). **Fauna**: 2 described spp., *C. ensifer* (Howard) and *C. ochraceipes* Gahan, and at least 4 undescribed spp.; world, 34 described spp. (see Noyes and Ren Hui 1987). **Hosts**: Diaspididae.

– Eye with posterior margin slightly concave, appearing slightly kidney-shaped; mandible tridentate .... ***Mahencyrtus*** Masi (part)

Fauna: 1 described sp., *M. perplexus* (Girault), throughout region, and 1 or 2 unidentified spp.; world, 6 described spp. **Hosts**: Pseudococcidae on grasses; possibly hyperparasites.

58(33) Funicle and scape broad and flat; scape not more than 4 times as long as broad 59

– Funicle cylindrical or, if flattened, scape more or less cylindrical and at least about 5 times as long as broad 61

59(58) Mesoscutum with anteromedian portion markedly raised above remainder, which is concave (Fig. 134); scrobes well marked and extending about two-thirds distance from toruli to anterior ocellus .... ***Mira*** Schellenberg (part)

Key: Bouček (1977). **Fauna**: 1 sp., *M. mucora* Schellenberg; world, 4 spp. **Hosts**: unknown, but probably Pseudococcidae on grasses.

– Mesoscutum uniformly convex; scrobes not extending beyond one-half distance from toruli to anterior ocellus 60

60(59) Clava white, contrasting with dark funicle, and narrow, its width less than one-half that of widest funicular segment; propodeum at midline less than one-quarter length of scutellum .... ***Epanusia*** Girault (part)

Fauna: 2 described spp., *E. albiclava* Girault and *E. xerophila* (Brues), and at least 1 undescribed sp. in USA (FL); world, 3 spp. **Hosts**: unknown, but probably Pseudococcidae associated with grasses.

– Clava dark, concolorous with funicle, and its width at least three-quarters that of widest funicular segment; propodeum at midline at least one-third length of scutellum .... ***Tetracnemus*** Westwood (part)

Fauna: 11 described spp. (some perhaps synonymous) and at least 5 undescribed spp.; world, about 25 spp. **Hosts**: Pseudococcidae in grassy habitats.

61(58) Head and mesosoma orange to dark brown, without any metallic green color 62

– Head or mesosoma at least partly metallic green, or brown with at least a slight metallic green or purplish sheen 79

62(61) Scutellum medially concave; axillae convex, raised above surface of scutellum (Figs. 114, 115) 63

– Scutellum flat or convex; axillae variable 64

63(62) Frontovertex wide, at narrowest point more than one-half width of head; scape widening apically into 2 flanges enclosing pedicel and basal funicular segments (Figs. 111, 114, 115); tegula orange; ovipositor not exserted ..... ***Holcencyrtus*** Ashmead (part)

Fauna: 4 described and at least 6 undescribed spp. (see Gordh and Trjapitzin 1980); world, 6 described spp. **Hosts**: unknown, but probably Pseudococcidae associated with grasses or ant nests.

– Frontovertex narrow, at narrowest point slightly more than one-quarter width of head; scape cylindrical; tegula white; ovipositor exserted .... ***Metanotalia*** Mercet

Fauna: 1 sp., *M. maderensis* (Walker) in USA (CA). **Hosts**: Pseudococcidae on grasses. [See Mercet (1921), Noyes (1988*a*).]

64(62) Scutellum with apical tuft of setae (Fig. 88) .... ***Encyrtus*** Latreille (part)

Key: Sugonjaev and Gordh (1981). **Fauna**: 8 described and 1 or 2 unidentified spp.; world, about 45 described spp. **Hosts**: Coccidae; *E. saliens* Prinsloo & Annecke introduced into USA (CA) to control *Pulvinaria delottoi* Gill and *P. mesembryanthemi* (Vallot) on ice plant (Aizoaceae) (see Hagen et al. 1989, Wright and Kerr 1988); *E. infelix* Embleton and *E. lecaniorum* (Mayr) are commonly reared from agricultural and horticultural coccid pests.

– Scutellum without apical tuft of setae 65

65(64) Head with scrobes sharply margined, and interantennal prominence narrowed dorsally to acute point (Fig. 19); hypopygium extending apically into narrow tongue .... ***Mucrencyrtus*** Noyes (part)

Key: Sharkov (1996). **Fauna**: 4 described spp.; world, 8 described spp. **Hosts**: Aclerdidae.

– Head with scrobes not sharply margined, and interantennal prominence dorsally rounded; hypopygium different 66

66(65) Propodeum at midline at least one-half length of scutellum 67

– Propodeum at midline less than one-quarter length of scutellum 70

67(66) Head with lower part wide, in frontal view with mouth cavity at least three-fifths width of head (Fig. 166) .... ***Tetracnemus*** Westwood, see 60

– Head with lower part conspicuously narrowed, in frontal view with mouth cavity at most one-half width of head 68

68(67) Flagellum with all funicular segments transverse, the flagellum less than 1.5 times as long as scape (Fig. 101); ovipositor at least slightly exserted; hypopygium not quite extending to apex of metasoma .... ***Formicencyrtus*** Girault (part)

Fauna: 2 described spp., *F. thoreauini* Girault and *F. neomexicanus* (Ashmead) (see Girault 1916*a*), and at least 2 undescribed spp.; Nearctic only. **Hosts**: Pseudococcidae.

– Flagellum with at least some funicular segments longer than broad, the flagellum about twice as long as scape (e.g., Fig. 86); ovipositor not exserted; hypopygium extending beyond apex of last metasomal tergum 69

69(68) Flagellum with clava white, contrasting with dark funicle, and all segments longer than broad (Fig. 86) .... ***Ectromatopsis*** Compere (part)

Fauna: 1 sp., *E. americana* (Howard) (see Compere 1947); Nearctic only. **Hosts**: Pseudococcidae in grassy habitats.

– Flagellum unicolorous dark brown, with some segments broad and flat, transverse or quadrate (Fig. 38) .... ***Anusioptera*** Brues (part)

Fauna: 1 described fully-winged sp., *A. aureocincta* Brues (see Rosen 1981), and 1 undescribed short-winged sp., in USA (AZ, CA, TX). **Hosts**: Pseudococcidae.

70(66) Funicle with all segments quadrate or longer than broad 71

– Funicle with at least some segments distinctly transverse 74

71(70) Notauli present and extending almost to posterior margin of mesoscutum .... ***Dusmetia*** Mercet

Fauna: 1 described sp., *D. ceballosi* Mercet, probably introduced into Canada (YT) and USA (WY); world, 5 spp. (see Kerrich 1964). **Hosts**: Pseudococcidae associated with grasses.

– Notauli absent 72

72(71) Funicle 7-segmented; clava 2-segmented (Fig. 37) .... ***Anomalicornia*** Mercet (part)

Fauna: 1 sp., *A. tenuicornis* Mercet (1921) in USA (FL), probably introduced; world: 1 sp. **Hosts**: Pseudococcidae associated with grasses.

– Funicle 6-segmented; clava 3-segmented 73

73(72) Frontovertex shiny and with raised, regular hexagonal, reticulate sculpture of mesh size greater than diameter of eye facet (Fig. 1) .... ***Gyranusoidea*** Compere (part)

Fauna: at least 5 undescribed spp.; world, 15 described spp. (see Prinsloo 1983, Noyes and Hayat 1994). **Hosts**: Pseudococcidae.

– Frontovertex matt and with rugose or minutely rugose sculpture, or, if with mesh-like sculpture, mesh size less than diameter of eye facet (e.g., Figs. 4, 5) .... ***Anagyrus*** Howard (part)

Keys (some spp. only): Timberlake (1924), Compere (1947). **Fauna**: 16 described and at least as many undescribed spp.; world, well over 125 spp. **Hosts**: Pseudococcidae (several spp. of *Anagyrus* were introduced into USA (CA, TX) and elsewhere for control of mealybug pests, e.g., *Anagyrus pseudococci* (Girault), *A. fusciventris* (Girault), and *A. saccharicola* Timberlake.

74(70) Mesoscutum strongly transverse, at least 3 times as broad as long 75

– Mesoscutum not more than 2 times as broad as long 76

75(74) Metasoma with cerci in basal third; clava white, contrasting with the dark brown funicle .... ***Neodusmetia*** Kerrich

Fauna/Hosts: 1 described sp., *N. sangwani* (Subba Rao) (see Kerrich 1964), introduced into USA (TX), Mexico, and other countries to control *Antonina graminis* (Maskell) (Pseudococcidae), a serious pest of range grasses (Dean et al. 1979).

– Metasoma with cerci in apical third; clava dark brown, darker than most funicular segments (Fig. 157) .... ***Satureia*** Noyes & Woolley

Fauna: 1 sp., *S. sidon* Noyes & Woolley (1994), in USA (FL).

76(74) Pronotum longitudinally divided; head prognathous, and almost always with 1 relatively long conspicuous seta between posterior ocellus and eye margin; body strongly flattened .... ***Rhopus*** Förster (part)

Fauna: 2 described spp., *R. americanus* (Girault) and *R. nigroclavatus* (Ashmead) (as *Xanthoencyrtus*), and 6 unidentified spp., throughout region; world, about 40 described spp. **Hosts**: Pseudococcidae associated with grasses.

– Pronotum not divided; head hypognathous or subprognathous, and setae on frontovertex more or less uniform in length; body usually not flattened, although sometimes slightly flattened 77

77(76) Ovipositor not exserted, or hardly so .... ***Metaphycus*** Mercet, see 39

– Ovipositor exserted, the exserted part at least one-quarter length of metasoma and at least 2 times as long as mesotibial spur 78

78(77) Ovipositor sheaths cylindrical; tegula white basally .... ***Aphycus*** Mayr (part)

Fauna: 3 described spp., *A. apicalis* (Dalman), *A. bifasciatus* (Timberlake), *A. io* (Williams), and doubtfully also *A. hederaceus* (Westwood), and at least 5 unidentified spp., throughout region; world, about 30 described spp. **Hosts**: Pseudococcidae.

– Ovipositor sheaths laterally flattened; tegula completely brown [antenna, Fig. 81] .... ***Ebito*** Noyes & Woolley

Fauna: 1 described sp., *E. dereus* Noyes & Woolley (1994) in USA (GA), and 2 undescribed spp. in USA (FL, OR).

79(61) Mesopleuron expanded, its posterior margin straight and touching base of metasoma along its entire height, and in lateral view more or less completely obscuring propodeum .... ***Austrochoreia*** Girault

Fauna: 1 undescribed sp. in USA (FL); world, 3 spp. (see Noyes 1988*a*). **Hosts**: Eriococcidae and Pseudococcidae.

– Mesopleuron not expanded, its posterior margin curved and not or hardly touching base of metasoma, the propodeum in lateral view clearly visible 80

80(79) Head with toruli on concave area set off from upper face by distinct, carinate ridge; scutellum frequently bearing scale-like setae; scape normally expanded and frequently with thin flanges on both inner and outer surfaces to accommodate pedicel and basal funicular segments (Figs. 26, 111, 112) 81

– Head with interantennal area, toruli, and scrobes not set off from upper face by distinct ridge; scutellum without scale-like setae; scape cylindrical but occasionally expanded, never with thin outer flange 82

81(80) Head and mesosoma orange or testaceous; scutellum metallic green, very smooth and highly polished, and apically without scale-like setae .... ***Aeptencyrtus*** De Santis

Fauna: 1 described sp., *A. bruchi* (De Santis) (see De Santis 1964), in USA (FL). **Hosts**: Pseudococcidae.

– Head and mesosoma dark, with metallic reflections; scutellum with at least some shallow sculpture basally, and apically frequently with some scale-like setae [habitus, Figs. 114, 115] .... ***Holcencyrtus*** Ashmead, see 63

82(80) Tegula white basally .... ***Pseudleptomastix*** Girault (part)

Key: Kerrich (1982). **Fauna**: 1 described sp., *P. squammulata* Girault, and at least 6 or 7 undescribed spp.; world, 2 described spp. **Hosts**: Pseudococcidae.

– Tegula completely brown 83

83(82) Ovipositor exserted, the exserted part at least one-third length of metasoma; occipital margin rounded; flagellum broadly flattened .... ***Tetracnemus*** Westwood, see 60

– Ovipositor not exserted, or hardly so; occipital margin acute; flagellum cylindrical 84

84(83) Flagellum with black and white segments; scutellum without thin apical flange .... ***Apoanagyrus*** Compere (part)

Key: Kerrich (1982). **Fauna**: 3 described spp., *A. argyrus* (Burks), *A. pallidipes* (Ashmead), and *A. californicus* Compere, and perhaps as many as 11 undescribed spp.; world, 6 described spp. **Hosts**: Pseudococcidae.

– Flagellum unicolorous, black; scutellum with distinct, thin apical flange .... ***Ericydnus*** Walker (part)

Fauna: 1 described sp., *E. lamasi* (Domenichini) (see Kerrich 1967, as *Grandoriella*), and at least 4 unidentified spp.; world, 22 described spp. (revision of western Palearctic spp.: Graham 1991). **Hosts**: Pseudococcidae.

85(31) Scutellum either with group of coarse setae arranged in more or less compact tuft or bundle (Figs. 64, 88), or with 2 or more scale-like setae (e.g., Fig. 103); antenna with scape and flagellum never both extremely broad, flattened and leaf-like 86

– Scutellum without distinct tuft or bundle of setae or scale-like setae or, if with such setae, both scape and flagellum extremely broad, flattened and leaf-like (e.g., Fig. 131) 92

86(85) Scutellum with 2 or more flattened, scale-like setae (Fig. 103), the setae not arranged in tuft 87

– Scutellum with tuft of long dark setae (e.g., Figs. 64, 88) 88

87(86) Scutellum with apical half having several scattered short, scale-like setae and pair of larger scale-like setae at apex; frontovertex narrow, one-fifth width of head; forewing with infuscation diffuse, not forming distinct pattern of hyaline and infuscate areas; body generally orange .... ***Lakshaphagus*** Mahdihassan

Fauna: 1 unidentified sp. in USA (FL, TX); world, 3 described spp. (see Hayat 1981). **Hosts**: Asterolecaniidae and Kerriidae.

– Scutellum with apex having pair of large, broad and flat scale-like setae (Fig. 103); frontovertex wider, one-third width of head; forewing with distinct pattern of triangular areas; body dark and metallic .... ***Habrolepis*** Förster

Key: Annecke and Mynhardt (1970). **Fauna**: 2 described spp., *H. dalmanni* (Westwood) and *H. rouxi* Compere; world, 21 described spp. **Hosts**: Diaspididae and Asterolecaniidae; *H. rouxi* introduced into USA (CA) to control *Aonidiella aurantii* Maskell on citrus (see Flanders 1944, Blumberg and DeBach 1979).

88(86) Mesoscutum with median tuft of setae, and posterior third with shallow transverse depression having silvery white setae .... ***Diversinervus*** Silvestri, see 38

– Mesoscutum without median tuft of setae, and posterior third without transverse depression, with or without silvery white setae 89

89(88) Postmarginal and stigmal veins each at least twice as long as marginal vein (Fig. 87) [scutellum and axillae, Fig. 88] .... ***Encyrtus*** Latreille, see 64

– Postmarginal and stigmal veins each shorter than marginal vein 90

90(89) Ovipositor exserted at least one-third length of metasoma; metasoma with hypopygium extending to apex, and with posterior margin of last tergum truncate .... ***Prochiloneurus*** Silvestri

Fauna: 3 described spp., *P. americanus* (Girault), *P. dactylopii* (Howard), and *P. modestus* (Timberlake) (see Peck 1963, as *Achrysopophagus*), and at least 2 undescribed spp. **Hosts**: hyperparasites of Pseudococcidae through Encyrtidae.

– Ovipositor, if exserted, less than one-third length of metasoma; metasoma with hypopygium extending at most one-half length of metasoma, and with posterior margin of last tergum tapered 91

91(90) Forewing completely hyaline; ovipositor not or barely exserted; metasoma with gland-like openings on Mt_2 and Mt_6 (best seen in slide–mounted material) (Fig. 173) .... ***Zaomma*** Ashmead (part)

Key: Gordh and Trjapitzin (1979). **Fauna**: 1 described sp., *Z. lambinus* (Walker), and 3 unidentified spp.; world, 13 described spp. (see Prinsloo 1979 for Afrotropical spp.). **Hosts**: hyperparasites of Diaspididae.

– Forewing infuscate, at least in center of wing behind marginal vein; ovipositor frequently exserted with exserted part at least one-fifth length of metasoma and at least as long as mesotibial spur; metasoma without gland-like openings .... ***Cheiloneurus*** Westwood, see 41

92(85) Scape not more than 3 times as long as broad 93

– Scape more than 3 times as long as broad 149

93(92) Flagellum broad and flat, with all funicular segments transverse except occasionally first segment (Figs. 56, 76, 131) 94

– Flagellum more or less cylindrical to broadly oval in cross section or, if appearing flat, at least first 2 funicular segments longer than broad 107

94(93) Linea calva closed, not reaching posterior margin of forewing (e.g., Fig. 35) 95

– Linea calva open and reaching posterior margin of forewing (e.g., Figs. 75, 108, 122), but occasionally interrupted by 1 line of setae on dorsal surface (e.g., Fig. 44) 98

95(94) Forewing densely setose and at least with 2 irregular, wavy dark fasciae beyond venation (Fig. 80) .... ***Dicarnosis*** Mercet

Key: Kerrich (1978). **Fauna**: 2 described spp., *D. ripariensis* Kerrich and *D. erythrocephala* Kerrich; world, 7 described spp. **Hosts**: Pseudococcidae.

– Forewing with normal setation and variably infuscate, but not with irregular, wavy dark fasciae beyond venation 96

96(95) Forewing with 2 longitudinal infuscate rays (Fig. 77); clava with apex transversely truncate (Fig. 76) .... ***Comperiella*** Howard

Key: Hayat (1977). **Fauna/Hosts**: 1 sp., *C. bifasciata* Howard, introduced into USA (CA) to control *Aonidiella aurantii* (Maskell) and *A. citrina* (Coquillett) on citrus (see Clausen 1978); world, 8 spp.

– Forewing without 2 distinct longitudinal infuscate rays; clava with apex rounded 97

97(96) Mesoscutum uniformly convex and without notauli; forewing without infuscate areas beyond venation .... ***Epanusia*** Girault, see 60

– Mesoscutum concave posterolaterally and with notauli in anterior half; forewing infuscate beyond venation .... ***Mira*** Schellenberg, see 59

98(94) Clava with apex rounded or transversely truncate 99

– Clava with apex obliquely truncate, the truncate area at least one-half as long as clava 100

99(98) Forewing 4 times as long as broad, and with marginal vein at least 10 times as long as broad; hypopygium extending to apex of metasoma; propodeal length at midline one-third length of scutellum; ovipositor well exserted, the exserted part at least one-third length of metasoma [illegible] longer than mesotibial spur .... ***Tetracnemus*** Westwood, see 60

– Forewing at most 3 times as long as broad (Fig. 57), and with marginal vein at most 5 times as long as broad; hypopygium not extending to apex of metasoma; propodeal length at midline much less than one-third length of scutellum; ovipositor not exserted [antenna, Fig. 56] .... ***Ceraptroceroideus*** Girault, see 36

100(98) Hypopygium extending to apex of metasoma; marginal vein punctiform and postmarginal vein long and curved 101

– Hypopygium not extending to apex of metasoma; marginal vein longer than broad, and postmarginal vein, if present, straight 103

101(100) Postmarginal vein longer than stigmal vein (Fig. 98) .... ***Extencyrtus*** Noyes & Woolley

Fauna: 1 sp., *E. edessa* Noyes & Woolley (1994), in USA (SC). **Hosts**: Pseudococcidae.

– Postmarginal vein not longer than stigmal vein 102

102(101) Forewing strongly incised at junction of submarginal and marginal veins; basal margin of linea calva without flattened scale-like setae; basal cell setose almost throughout (Fig. 44) .... ***Avernes*** Noyes & Woolley

Fauna: 1 sp., *A. gela* Noyes & Woolley (1994), in Canada (PQ), USA (TX), and Mexico (Guerrero, Jalisco). **Hosts**: Pseudococcidae.

– Forewing not or only weakly incised at junction of submarginal and marginal veins; basal margin of linea calva with at least a few scale-like setae anteriorly; basal cell bare in basal half (Fig. 66) .... ***Chrysoplatycerus*** Ashmead

Key: Kerrich (1978). **Fauna**: 2 described spp., *C. ferrisi* Timberlake and *C. splendens* (Howard), and 1 undescribed sp.; world, 4 described spp. **Hosts**: Pseudococcidae.

103(100) Eye separated from occipital margin by more than diameter of posterior ocellus; head with vertex not separated from face by frontofacial ridge, the face gradually curved into vertex, and in frontal view head at least 1.25 times as high as broad; notauli sometimes present and complete .... ***Formicencyrtus*** Girault, see 68

– Eye separated from occipital margin by less than diameter of posterior ocellus; head with vertex separated from upper face by frontofacial ridge, the face clearly forming an angle with vertex, and in frontal view head at most 1.1 times as high as broad; notauli absent 104

104(103) Head with frontofacial ridge interrupted by interantennal prominence .... ***Ammonoencyrtus*** De Santis

Key: Annecke (1967). **Fauna**: 1 described sp., *A. californicus* (Compere), and possibly 2 more spp.; world, 2 described spp. **Hosts**: Coccidae.

– Head with frontofacial ridge continuous across face 105

105(104) Forewing with central, longitudinal infuscate ray extending to apex of wing (Fig. 54), and with transverse infuscate bands extending to anterior and posterior margins of wing; submarginal vein with triangular expansion in apical third (Fig. 55) .... ***Cerapterocerus*** Westwood, see 37

– Forewing with diffuse infuscation, without a central longitudinal infuscate ray and with apex of wing hyaline; submarginal vein without triangular expansion 106

106(105) Forewing infuscation enclosed subapically by darker band (Fig. 36); head with short, transverse dark band below frontofacial ridge, and frontovertex smooth; scutellum with sculpture deeper than sculpture of mesoscutum .... ***Anicetus*** Howard, see 37

– Forewing disc evenly infuscate, without darker subapical band; head without transverse dark band below frontofacial ridge, and frontovertex with punctate sculpture; sculpture of scutellum more or less similar to sculpture of mesoscutum .... ***Eusemion*** Dahlbom

Fauna: 2 described spp., *E. cornigerum* (Walker) and *E. longipennis* (Ashmead), the species possibly synonymous (see Annecke 1967); world, 2 described spp. **Hosts**: hyperparasites of Eriococcidae and Coccidae.

107(93) Head with interantennal prominence sharply margined and tapered dorsally to sharp point (Fig. 19); hypopygium with median tongue-like extension extending to apex of metasoma .... ***Mucrencyrtus*** Noyes, see 65

– Head with interantennal prominence not sharply margined, dorsally rounded; hypopygium often extending to apex of metasoma, but without median tongue-like extension 108

108(107) Forewing infuscate or appearing infuscate because of very distinct pattern of dark and pale setae, excluding specimens with very indistinct suffusion of yellow or pale brown or with very small spot behind marginal vein, the spot not or hardly extending past apex of stigmal vein 109

– Forewing hyaline, or specimen with very indistinct suffusion of yellow or pale brown, or small spot behind marginal vein not or hardly extending past apex of stigmal vein (e.g., Figs. 79, 139) 125

109(108) Clava with apex strongly, obliquely truncate, the truncate part clearly longer than remaining ventral surface of clava (e.g., Fig. 31); forewing without well-defined stripes and fasciae 110

– Clava with apex more or less rounded (e.g., Fig. 126) or transversely truncate or, if appearing obliquely truncate, either truncate part shorter than remaining portion of ventral surface of clava or forewing with strong pattern of well-defined stripes and fasciae 114

110(109) Head and mesosoma dorsally entirely orange or nearly so, not metallic 111

– Head and mesosoma dorsally entirely dark and with metallic green, blue or purple sheen 112

111(110) Head with scrobes deep and set off from upper face by distinct, sharp carinate ridge; pedicel dorsally frequently with elongate scale-like setae; head shape sometimes bizarre .... ***Hambletonia*** Compere (part)

Fauna: 1 described sp., *H. pseudococcina* Compere (1936), introduced into USA (FL) to control *Dysmicoccus brevipes* (Cockerell) (see Clausen 1978), and at least 2 undescribed spp.; world, 1 described sp. **Hosts**: Pseudococcidae.

– Head with scrobes shallow and not set off from upper face by distinct carinate ridge; pedicel without elongate scale-like setae; head shape normal .... ***Atropates*** Howard

Fauna: 1 described sp., *A. collinsi* Howard. **Hosts**: Coccidae.

112(110) Clava about one-half as long as funicle; forewing without postmarginal vein; head and mesosoma dorsally with fine, deeply punctate-reticulate sculpture .... ***Comperia*** Gomes

Key: Prinsloo and Annecke (1978). **Fauna**: 1 described sp., *C. merceti* (Compere); world, 7 described spp. **Hosts**: *C. merceti* is a parasite of eggs of cockroaches (Blattaria) (see Gordh 1973*b*).

– Clava as long as funicle or nearly so; forewing with postmarginal vein at least about as long as stigmal vein; head and mesosoma dorsally with relatively shallow sculpture 113

113(112) Scutellum polished, almost without sculpture, and not margined except at extreme apex; eye bare .... ***Zarhopalus*** Ashmead (part)

Key: Kerrich (1967). **Fauna**: 3 described spp., *Z. corvinus* (Girault), *Z. inquisitor* (Howard), and *Z. sheldoni* Ashmead, and at least 1 undescribed sp.; world, 5 described spp. **Hosts**: Pseudococcidae; *Z. corvinus* and *Z. sheldoni* were introduced into Canada to control *Pseudococcus maritimus* (Ehrhorn) in greenhouses (see McLeod 1962), and both spp. were introduced into other countries for biological control of *P. comstocki* (Kuwana) and *P. maritimus* (see Clausen 1978).

– Scutellum with reticulate sculpture and a carinate margin laterally and posteriorly; eye distinctly hairy .... ***Aenasius*** Walker (part)

Key: Kerrich (1967) (in part as *Chalcaspis*). **Fauna**: 9 described spp.; world, 30 spp. **Hosts**: Pseudococcidae.

114(109) Hypopygium extending at most two-thirds length of metasoma 115

– Hypopygium extending to apex of metasoma 119

115(114) Body extremely flattened and leaf-like; submarginal vein with distinct subapical triangular expansion (Fig. 47) .... ***Boucekiella*** Hoffer (part)

Fauna: 1 sp., *B. depressa* Hoffer, introduced into USA (TX) to control *Antonina graminis* (Maskell) (see Dean and Schuster 1958). **Hosts**: Aclerdidae and Pseudococcidae on *Phragmites*.

– Body relatively robust, not flattened and leaf-like; submarginal vein without subapical triangular expansion 116

116(115) Forewing with well-marked pattern of triangular hyaline areas and radiating infuscate areas (Fig. 91); head with line of silvery setae across frontovertex above scrobes and below eyes .... ***Epitetracnemus*** Girault (part)

Key: Noyes and Ren Hui (1987). **Fauna**: 1 described sp., *E. intersectus* (Fonscolmbe) [= *E. zetterstedtii* (Westwood)]; world, 5 described spp. **Hosts**: Diaspididae.

– Forewing without pattern of triangular hyaline areas, either with diffuse infuscate areas, or hyaline bands or irregular infuscate; head without line of silvery setae across face below eyes 117

117(116) Linea calva interrupted (e.g., Figs. 102, 149) or closed (e.g., Fig. 35) by several lines of setae on dorsal surface; mesoscutum almost always with notauli, the notauli sometimes reaching posterior margin of mesoscutum .... ***Metaphycus*** Mercet, see 39

– Linea calva open, entire (e.g., Figs. 75, 108, 122); mesoscutum without notauli 118

118(117) Forewing infuscate with 1 or 2 hyaline bands beyond venation .... ***Microterys*** Thomson, see 49

– Forewing with diffuse infuscation, the wing completely hyaline beyond venation .... ***Deilio*** Noyes & Woolley (part)

Fauna: 1 sp., *D. xylococculi* (Beardsley & Gordh) (see Noyes and Woolley 1994). **Hosts**: Margarodidae (see Beardsley and Gordh 1988).

119(114) Linea calva interrupted by setae on dorsal surface (e.g., Figs. 102, 149) or closed (e.g., Fig. 35) 120

– Linea calva neither interrupted by setae on dorsal surface nor closed (e.g., Figs. 75, 108, 122) 122

120(119) Funicle with all segments broader than long; pronotum lighter than mesoscutum; mesoscutum sometimes with notauli; mandible tridentate .... ***Metaphycus*** Mercet, see 39

– Funicle with all segments longer than broad; pronotum same color as mesoscutum; mesoscutum without notauli; mandible bidentate (e.g., Fig. 33) 121

121(120) Postmarginal vein longer than stigmal vein; frontovertex with regular, raised, hexagonal sculpture (e.g., Fig. 1) .... ***Gyranusoidea*** Compere, see 73

– Postmarginal vein shorter than stigmal vein; frontovertex with irregular, minutely rugose or matt sculpture (e.g., Figs. 4, 5) ... . ***Anagyrus*** Howard, see 73

122(119) Forewing with marginal vein punctiform and with bare hyaline streak connecting apices of postmarginal and stigmal veins (Fig. 144); scutellum sharply margined laterally and posteriorly and with slight median longitudinal ridge (Fig. 145); mesoscutum and scutellum dark, metallic, without any yellow color .... ***Pentelicus*** Howard (part)

Key: Trjapitzin and Gordh (1979*b*) (part, as *Hemaenasius*). **Fauna**: 3 described spp., *P. aldrichi* Howard, *P. confusus* (Ashmead), and *P. varicornis* (Girault), and 1 undescribed sp.; world, 5 described spp. **Hosts**: larvae of Sphindidae (see McHugh 1993).

– Forewing with marginal vein at least twice as long as broad and without bare hyaline streak connecting apices of postmarginal and stigmal veins; scutellum not sharply margined laterally or posteriorly and without median longitudinal ridge; mesoscutum and scutellum usually with some yellow color or entirely yellow 123

123(122) Mesosoma and metasoma mostly yellow; ovipositor exserted at least one-quarter length of metasoma; mesoscutum with notauli extending at least half way to transscutal articulation (sometimes difficult to see on card- or point-mounted specimens) [habitus, Fig. 127] .... ***Mariola*** Noyes (part)

Fauna: 1 sp., possibly *M. flava* Noyes (1980); world, 1 described sp. **Hosts**: Eriococcidae.

– Mesoscutum and scutellum dark and metallic, sometimes with some yellow or orange color laterally; ovipositor not exserted more than one-fifth length of metasoma; mesoscutum without notauli 124

124(123) Costal cell with at least 1 line of setae on dorsal surface extending entire length of cell (Fig. 148); hypopygium not extending more than one-half length of metasoma; body completely dark brown, sometimes with metallic green sheen .... ***Pseudencyrtus*** Ashmead, see 56

– Costal cell with 1 line of setae on dorsal surface in apical half only (Fig. 119); hypopygium extending to apex of metasoma or, if only extending one-half its length, body extensively marked with yellow or orange [antenna, Fig. 120] .... ***Islawes*** Noyes & Woolley

Fauna: 1 described sp., *I. azteca* Noyes & Woolley (1994), and at least 3 undescribed spp., in Mexico (Michoacan).

125(108) Mesoscutum or scutellum at least partly yellow, orange, or orange-brown 126

– Mesoscutum and scutellum completely dark 132

126(125) Head with deep scrobes set off from frontovertex by carinate ridge; pedicel often with group of strongly upright setae; clava 1-segmented; head shape often bizarre .... ***Hambletonia*** Compere, see 111

– Head with scrobes not set off from frontovertex by carinate ridge; pedicel without group of strongly upright setae; clava 3-segmented; head shape normal, although sometimes flattened 127

127(126) Ovipositor exserted at least one-third length of metasoma; linea calva not interrupted or closed by setae on dorsal surface; minimum width of frontovertex about half width of head .... ***Mariola*** Noyes, see 123

– Ovipositor at most only slightly exserted; linea calva interrupted or closed by setae on dorsal surface; frontovertex with minimum width usually less than one-half width of head 128

128(127) Funicle with all segments longer than broad, and basal segments at least twice as long as broad 129

– Funicle with segments transverse, subquadrate or hardly longer than broad 131

129(128) Sculpture on frontovertex, mesoscutum and scutellum more or less the same, minutely rugose or matt (e.g., Figs. 4, 21) .... ***Anagyrus*** Howard, see 73

– Sculpture on frontovertex minutely reticulate with hexagonal cells (Figs. 1, 2); mesoscutum and scutellum reticulate or minutely punctate; sculpture on scutellum generally deeper than on mesoscutum (Fig. 22) 130

130(129) Postmarginal vein longer than stigmal vein .... ***Gyranusoidea*** Compere, see 73

– Postmarginal vein shorter than stigmal vein .... ***Apoanagyrus*** Compere, see 84

131(128) Pronotum longitudinally divided; body dorsoventrally flattened; mesoscutum without notauli; frontovertex with minimum width more than half width of head .... ***Rhopus*** Förster, see 76

– Pronotum not divided; body robust; mesoscutum often with notauli, at least anteriorly; frontovertex with minimum width less than one-half width of head .... ***Metaphycus*** Mercet, see 39

132(125) Tegula basally yellow or yellowish white .... ***Blastothrix*** Mayr (part)

Keys: Sugonjaev (1983, 1989). **Fauna**: 4 described and 1 undescribed spp. in Canada and northern USA; world, about 30 described spp. **Hosts**: Coccidae and Kermesidae.

– Tegula completely brown 133

133(132) Hypopygium not extending more than four-fifths length of metasoma; clava either 1- or 3-segmented; eye of normal size, at least about as long as minimum width of frontovertex 134

– Hypopygium extending more or less to apex of metasoma or, if about four-fifths its length, eye small and clearly shorter than minimum width of frontovertex and clava 2- or 3-segmented 143

134(133) Clava 1-segmented; postmarginal vein at least 1.5 times as long as stigmal vein 135

– Clava 3-segmented; postmarginal vein at most about as long as stigmal vein 136

135(134) Scutellum and mesoscutum with deep longitudinal striate sculpture; funicle with first 2 segments shorter than third .... ***Ageniaspis*** Dahlbom (part)

Fauna: 2 described spp., *A. atricollis* (Dalman) and *A. fuscicollis* (Dalman), and 1 undescribed sp.; world, 9 described spp. **Hosts**: polyembryonic parasites of larvae of microlepidoptera, especially Yponomeutidae; *A. atricollis* and *A. fuscicollis* introduced to control *Yponomeuta padella* (L.), on apple (Unruh et al. 1993, IIBC 1991).

– Scutellum with deep longitudinal striate sculpture contrasting greatly with shallow reticulate sculpture of mesoscutum; funicle with first 3 segments subequal in length ...... ***Paraleurocerus*** Girault
Fauna: 1 described sp., *P. bicoloripes* Girault (1915); world, 3 described spp. **Hosts**: polyembryonic parasites of Gracillariidae.

136(134) Linea calva closed (e.g., Fig. 35) or interrupted by several lines of setae on dorsal surface (e.g., Figs. 102, 149) .... ***Metaphycus*** Mercet, see 39

– Linea calva open and not interrupted (e.g., Figs. 75, 108, 122), except occasionally by 1 or 2 setae on dorsal surface 137

137(136) Submarginal vein with triangular expansion in apical third (Fig. 172); clava apically with strong oblique truncation, the truncate part at least one-half as long as clava .... ***Tyndarichus*** Howard (part)
Key: Gordh and Trjapitzin (1981). **Fauna**: 1 described sp., *T. americanus* Gordh & Trjapitzin, and 2 undescribed spp.; world, 5 described spp. **Hosts**: hyperparasites of larvae of Lepidoptera through *Copidosoma* spp.; in other regions *Tyndarichus* recorded from chalcidoid primary parasites of Lepidoptera.

– Submarginal vein without triangular expansion in apical third; clava apically rounded or weakly truncate 138

138(137) Mesopleuron expanded and touching base of metasoma, or nearly so, and in lateral view clearly separating propodeum from metacoxa (Fig. 7) .... ***Ooencyrtus*** Ashmead, see 55

– Mesopleuron not expanded and in lateral view separated from metasoma, the propodeum touching metacoxa (e.g., Fig. 8) 139

139(138) Costal cell with at least 1 complete line of setae on dorsal surface extending entire length of cell (Fig. 148) .... ***Pseudencyrtus*** Ashmead, see 56

– Costal cell with 1 line of setae on dorsal surface extending at most about two-thirds distance towards base of cell 140

140(139) Ovipositor exserted, the exserted part at least one-third length of metasoma [antenna, Fig. 106] .... **Helygia** Noyes & Woolley (part)

Fauna: 1 described sp., *H. anna* Noyes & Woolley (1994), in southeast USA, and 1 undescribed sp.

– Ovipositor not or hardly exserted 141

141(140) Eye with dense, conspicuous, dark setae, each seta longer than width of a facet .... **Exoristobia** Ashmead (part)

Fauna: 1 described sp., *E. pleuralis* (Ashmead), and 1 unidentified sp.; world, 7 described spp. (see Subba Rao 1970). **Hosts**: pupae of Syrphidae, Tachinidae, and Phoridae.

– Eye apparently bare, the setae relatively sparse, pale, and shorter than width of a facet 142

142(141) Torulus at or above ventral margin of eye, separated from mouth margin by more than its own length; flagellum with segments subequal in size; linea calva interrupted by 1 or 2 setae on dorsal surface (Fig. 102) .... **Gahaniella** Timberlake (part)

Fauna: 3 described spp., *G. californica* Timberlake, *G. incerta* Howard, and *G. saissetiae* Timberlake, and at least 1 undescribed sp. in USA (FL); world, 4 described spp. (see Kerrich 1953). **Hosts**: hyperparasites of Coccidae and Pseudococcidae through other Encyrtidae.

– Torulus well below ventral margin of eye, separated from mouth by less than its own length; flagellum with segments increasing in size apically; linea calva not interrupted by setae .... **Deilio** Noyes & Woolley, see 118

143(133) Linea calva interrupted or completely closed by numerous setae on dorsal surface; funicle with all segments longer than broad 144

– Linea calva entire and open; funicle with all segments transverse or occasionally with 1 or 2 segments quadrate 145

144(143) Frontovertex with matt or rugose sculpture (Fig. 4) .... **Anagyrus** Howard, see 73

– Frontovertex with regular hexagonal, reticulate sculpture (Fig. 2) .. .. **Apoanagyrus** Compere, see 84

145(143) Frontovertex with conspicuous piliferous punctures, the diameter of each puncture about equal to distance between punctures and to diameter of ocellus, giving frontovertex appearance of surface of golf ball or thimble; forewing with stigmal vein long and curved, and postmarginal vein about as long as stigmal vein (Fig. 24) .... ***Aenasius*** Walker, see 113

– Frontovertex sculptured differently; forewing with stigmal vein straight, and postmarginal usually shorter than stigmal vein 146

146(145) Flagellum with clava white and funicle dark brown (Fig. 154) ....***Sarisencyrtus*** Noyes & Woolley

Fauna: 1 described sp., *S. beckeri* Noyes & Woolley (1994), in eastern USA.

– Flagellum unicolorous dark brown 147

147(146) Scutellum with distinct sculpture more or less similar to sculpture of mesoscutum .... ***Coelopencyrtus*** Timberlake (part)

Fauna: 2 described spp., *C. hylaei* Burks and *C. hylaeoleter* Burks (Burks 1958); world, 25 described spp. **Hosts**: gregarious or perhaps polyembryonic parasites of Apidae and Vespidae.

– Scutellum more or less without sculpture and very shiny, conspicuously smoother than mesoscutum 148

148(147) Frontovertex narrower than length of eye; clava 3-segmented .... ***Cerchysiella*** Girault (part)

Key: Noyes (1979) (New World spp., as *Zeteticontus*). **Fauna**: 4 described spp., *C. insularis* (Howard), *C. laevigatus* (De Santis), *C. scutellatus* (Howard), and *C. utilis* (Noyes), and 1 undescribed sp.; world, 21 described spp. **Hosts**: Coleoptera, especially Nitidulidae; C. *utilis* imported into USA (OH) to control nitidulid pests of fruit (Noyes 1982).

– Frontovertex broader than length of eye; clava 2- or 3-segmented .. ..***Zaommoencyrtus*** Girault, see 18

149(92) Clava 1-segmented and strongly obliquely truncate, with truncate part at least one-half as long as clava (Figs. 117, 121) (CAUTION: longitudinal sensilla sometimes aligned so clava appears segmented); mesoscutum with notauli extending at least halfway across mesoscutum; hypopygium extending more or less to apex of metasoma 150

– Clava not strongly obliquely truncate or, if so, notauli absent or clava 3-segmented (CAUTION: sutures occasionally interrupted ventrally) or hypopygium not extending more than two-thirds length of metasoma 151

150(149) Mesoscutum with notauli complete; flagellum filiform, with sixth funicular segment not or hardly wider than first segment; stigmal vein forming strongly acute angle with anterior margin of forewing (Fig. 118); eye with posterior margin distinctly concave, appearing kidney-shaped .... ***Homalotylus*** Mayr

Key: Timberlake (1919*b*). **Fauna**: 9 described spp.; world, 28 described spp. **Hosts**: gregarious parasites of predatory larvae of Coccinellidae.

– Mesoscutum with notauli extending about halfway across mesoscutum; flagellum distinctly wider apically, with sixth funicular segment at least 1.5 times wider than first segment; stigmal vein forming about 60° angle with anterior margin of forewing (e.g., Fig. 116); eye with posterior margin more or less straight, or barely concave .... ***Isodromus*** Howard

Key: Timberlake (1919*b*). **Fauna**: 6 described spp.; world, 16 described spp. **Hosts**: larvae of Chrysopidae and Hemerobiidae.

151(149) Head with interantennal prominence strongly produced as angular projection between toruli and mouth margin (Fig. 20) .... ***Paratetracnemoidea*** Girault

Fauna: 1 described sp., *P. americana* Gordh (1985), and 1 undescribed sp.; world, 4 described spp.

– Head with interantennal prominence not strongly produced as angular projection 152

152(151) Funicle with all segments longer than broad 153

– Funicle not with all segments longer than broad 224

153(152) Forewing infuscate or with distinct pattern of pale and dark setae, excluding those species with a very indistinct suffusion of yellow or pale brown or with a very small spot beneath the marginal vein which does not or hardly extends past the apex of the stigmal vein 154

– Forewing hyaline, with uniformly colored setae, or with a very indistinct suffusion of yellow or pale brown, or with a small spot beneath the marginal vein which does not or hardly extends past apex of stigmal vein 175

154(153) Torulus about midway between anterior ocellus and mouth margin, the toruli much closer to each other than to mouth margin [habitus, Fig. 109] .... ***Hexacladia*** Ashmead, see 32

– Torulus much closer to mouth margin than to anterior ocellus, the toruli not or hardly closer to each other than to mouth margin 155

155(154) Hypopygium extending to apex of metasoma or very nearly so 156

– Hypopygium not extending more than three-quarters length of metasoma 167

156(155) Linea calva closed by several lines of setae (Fig. 35) or interrupted by line of setae on dorsal surface (e.g., Fig. 149) 157

– Linea calva open and not interrupted 164

157(156) Ovipositor exserted at least one-half length of metasoma 158

– Ovipositor not exserted more than one-quarter length of metasoma 159

158(157) Forewing with marginal vein as long as broad, and postmarginal and stigmal veins much longer than marginal vein (Fig. 35); pronotum with dorsal margin pale, contrasting with black mesoscutum; tibiae banded with alternating light and dark color .... ***Anagyrus*** Howard, see 73

– Forewing with marginal vein at least 4 times as long as broad, and postmarginal and stigmal veins much shorter than marginal vein (Fig. 168); pronotum with dorsal margin same color as mesoscutum; tibiae not banded .... ***Tineophoctonus*** Ashmead

Fauna: 2 described spp., *T. armatus* (Ashmead) and *T. tineaevorus* (Ashmead); world, 3 described spp. **Hosts**: parasites of gall-inhabiting Tineidae and Cynipidae; recorded also from Anobiidae and Cerambycidae.

159(157) Postmarginal vein longer than stigmal vein 160

– Postmarginal vein not longer than stigmal vein 163

160(159) Scutellum and mesoscutum shiny, with similar shallow reticulate sculpture .... ***Leptomastix*** Förster (part)

Fauna/Hosts: 1 sp., *L. dactylopii* Howard (see Compere 1939), introduced into North America to control *Planococcus citri* (Risso) (Pseudococcidae) in greenhouses, and in USA (CA) to control *P. citri* on citrus; world, 33 spp.

– Scutellum matt, with deeply reticulate or rugose sculpture contrasting with shallower sculpture of mesoscutum 161

161(160) Tegula basally bright white .... ***Pseudleptomastix*** Girault, see 82

– Tegula basally orange or brown 162

162(161) Forewing with at most 2 incomplete oblique infuscate bands extending from submarginal and stigmal veins, the bands not reaching posterior margin of wing .... ***Gyranusoidea*** Compere, see 73

– Forewing with 3 transverse infuscate bands, 1 incomplete band from submarginal vein, 1 complete band from stigmal and postmarginal veins, and 1 complete subapical band (Fig. 124). .... ***Leptomastidea*** Mercet

Fauna/Hosts: 1 sp., *L. abnormis* (Girault), introduced into USA (CA) to control *Planococcus citri* on citrus [see Beardsley (1969) and Noyes (1988*a*)] and throughout North America to control this pest in greenhouses; world, not more than 20 described spp.

163(159) Head with scrobes deep, and interantennal prominence sharply margined and dorsally extended to acute point (Fig. 19); postmarginal vein shorter than stigmal vein or absent; eye rounded, hardly longer than broad .... ***Mucrencyrtus*** Noyes, see 65

– Head with scrobes shallow, and interantennal prominence different; postmarginal vein as long as stigmal vein; eye narrow, twice as long as broad .... ***Ectromatopsis*** Compere, see 69

164(156) Flagellum with funicular segments flattened, widest in middle and tapered toward each end (Fig. 38); forewing with infuscate area extending from marginal vein to posterior margin of wing, the infuscate area bordered by darker setae; basal cell without setae; stigmal vein nearly perpendicular to anterior margin of forewing (Fig. 39); propodeum at least one-half as long as scutellum .... ***Anusioptera*** Brues, see 69

– Flagellum with funicular segments cylindrical or oval in cross-section, not widest in middle; forewing with infuscation different; basal cell with some setae; stigmal vein at acute angle to anterior margin of forewing; propodeum at most one-third length of scutellum 165

165(164) Postmarginal vein longer than stigmal vein and twice as long as marginal vein (Fig. 93); funicle with first segment more than twice as long as pedicel; scutellum with thin, sometimes translucent, apical flange .... ***Ericydnus*** Walker, see 84

– Postmarginal vein not longer than stigmal or marginal vein; funicle with first segment subequal to or slightly longer than pedicel; scutellum without thin apical flange 166

166(165) Ovipositor exserted at least one-third length of metasoma; torulus less than its own length from mouth margin; tegula with base yellow .... ***Epicerchysius*** Girault

Fauna: 1 sp., *E. xanthipes* Girault (1915).

– Ovipositor exserted at most one-quarter length of metasoma; torulus at least its own length from mouth margin; tegula completely dark .... ***Ginsiana*** Erdös & Novicky (part)

Fauna: 4 described spp., *G. arbuticola* (Gahan & Waterston), *G. boharti* Gordh & Trjaptizin, *G. richardsi* (Barron), and *G. vectius* (Walker); world, 10 described spp. (see Gordh and Trjapitzin 1981, Noyes and Woolley 1994). **Hosts**: nymphs of Psyllidae.

167(155) Forewing infuscate from about parastigma to apex of wing except for complete hyaline fascia beyond venation 168

– Forewing infuscation different, without complete hyaline fascia beyond venation 169

168(167) Head dark with transverse pale bands on face, with very shallow scrobes, and with interantennal prominence rounded dorsally and not sharply margined .... ***Neococcidencyrtus*** Compere, see 46

– Head completely orange, with deep scrobes, and with interantennal prominence sharply margined dorsally and tapered to a sharp point .... ***Aloencyrtus*** Prinsloo (part)

Fauna: 2 spp., *A. saissetiae* (Compere) and *A. niloticus* (Compere), introduced into USA (CA) to control *Saissetia oleae* (Olivier) (Coccidae) on citrus, but probably not established (Clausen 1978); world, 16 described spp. (all Afrotropical) (see Prinsloo 1978; Annecke 1964, as *Coccidoxenus*).

169(167) Forewing almost completely infuscate with only extreme apex hyaline .... ***Discodes*** Förster (part)

Key: Sugonjaev (1989). **Fauna**: 3 described spp., *D. arizonensis* (Howard), *D. cowboy* Sugonjaev, and *D. unicolor* (Ashmead); world, 35 described spp. **Hosts**: Coccoidea.

– Forewing infuscate only in middle one-third or less, with at least base and apical one-third hyaline 170

170(169) Eye nearly reaching mouth margin, the malar space less than one-quarter length of eye; eye with posterior margin slightly concave, almost kidney-shaped .... ***Parablastothrix*** Mercet (part)

Fauna: 1 described sp., *P. nearctica* Miller (see Miller 1965), and at least 1 unidentified sp.; world, 16 described spp. **Hosts**: larvae of Lyonetiidae and Nepticulidae.

– Eye well separated from mouth margin, the malar space at least one-third length of eye; eye with posterior margin straight or concave 171

171(170) Metasoma not longer than mesosoma and apically more or less rounded; ovipositor not exserted .... ***Pseudencyrtoides*** Gordh & Trjapitzin

Fauna: 1 described sp., *P. cupressi* Gordh & Trjapitzin (1975). **Hosts**: Cecidomyiidae.

– Metasoma longer than mesosoma and apically acute; ovipositor at least slightly exserted 172

172(171) Mesoscutum covered with conspicuous silvery setae; postmarginal vein longer than stigmal vein .... ***Cheiloneurus*** Westwood, see 41

– Mesoscutum covered with brown, sometimes translucent, setae; postmarginal vein shorter than stigmal vein 173

173(172) Metasoma partly yellow; legs, including coxae, entirely yellow except for brown metatibia; postmarginal vein at least as long as stigmal vein .... ***Syrphophagus*** Ashmead (part)

Fauna: 6 described spp. [only 1 known sp., *S. marilandicus* (Girault), keys out here] and at least 3 unidentified spp.; world, about 60 described spp. **Hosts**: primary parasites of larvae of Syrphidae feeding on Aphididae and hyperparasites of Aphididae and Psyllidae through Braconidae and Aphelinidae.

– Metasoma entirely dark brown or black; legs with at least some dark brown areas; postmarginal vein clearly shorter than stigmal vein 174

174(173) Scutellum flat, shiny, and either with sculpture clearly much shallower than on mesoscutum or without sculpture; frontovertex more than one-quarter width of head [antenna, Fig. 141] .... ***Pawenus*** Noyes & Woolley (part)

Fauna: 1 described sp., *P. orthopterae* Noyes & Woolley (1994), in eastern USA (NC, PA) and northern Mexico (Tamaulipas and Nuevo Leon). **Hosts**: eggs of *Pterophylla* (Tettigoniidae).

– Scutellum convex, hardly shiny, and with sculpture much deeper than on mesoscutum; frontovertex less than one-quarter width of head .... ***Psilophryoidea*** Compere (part)

Fauna: 1 described sp., P. *comesor* Compere (1928), and 1 undescribed sp. **Hosts**: Kermesidae.

175(153) Linea calva interrupted by at least 1 line of setae on dorsal surface (Figs. 102, 149); postmarginal vein not longer than stigmal vein or, if so, ovipositor hardly exserted 176

– Linea calva not interrupted (e.g., Fig. 51) (sometimes closed posteriorly) or, if closed by 1 or 2 setae on dorsal surface, postmarginal vein longer than stigmal vein and ovipositor exserted more than one-half length of metasoma 188

176(175) Head and mesosoma metallic green with fine punctate-reticulate sculpture; postmarginal vein at least a little longer than stigmal vein .... ***Blastothrix*** Mayr, see 132

– Head and mesosoma different or, if metallic green with fine punctate-reticulate sculpture, postmarginal vein at least a little shorter than stigmal vein 177

177(176) Hypopygium not extending past basal two-thirds of metasoma or head and mesosoma strongly metallic green, blue, or purplish; mandible tridentate or with 1 or 2 teeth and a truncation, never bidentate 178

– Hypopygium extending to apex of metasoma; head and mesosoma never distinctly metallic, occasionally dark brown or black and slightly shiny, sometimes with very weak green sheen; mandible usually bidentate (e.g., Fig. 33), sometimes tridentate 180

178(177) Stigmal vein apically truncate, without uncus, and with sensilla arranged in a square (e.g., Fig. 79); mandible tridentate .... ***Copidosoma*** Ratzeburg, see 30

– Stigmal vein not apically truncate, with uncus, and with sensilla not arranged in a square; mandible with 1 or 2 teeth and a truncation (e.g., Figs. 68, 147) 179

179(178) Flagellum with apical segments clearly larger (longer or broader) than basal segments, and pedicel clearly longer than first funicular segment; mesoscutum and scutellum flat, and scutellum polished at extreme apex; scape at least 1.2 times as long as malar space, usually longer; occipital margin rounded .... ***Coccidencyrtus*** Ashmead, see 57

– Flagellum with segments subequal in size to pedicel; mesoscutum and scutellum convex, and scutellum uniformly sculptured to apex; scape not longer than malar space; occipital margin sharp .... ***Gahaniella*** Timberlake, see 142

180(177) Mesoscutum with notauli in anterior half; mesotibia with pair of sometimes faint, brown rings; marginal vein punctiform (Fig. 96); mandible tridentate [antenna, Fig. 97] .... ***Euogus*** Noyes & Woolley

Fauna: 1 described sp., *E. ravenna* Noyes & Woolley (1994) in USA (TX), and 1 undescribed sp.

– Mesoscutum without notauli; mesotibia not even with faint brown rings; marginal vein at least slightly longer than broad; mandible bidentate (e.g., Fig. 33) 181

181(180) Clava 2-segmented and funicle 7-segmented; pedicel and flagellum together as long as mesosoma and metasoma combined (Fig. 37) .... ***Anomalicornia*** Mercet, see 72

– Clava 3-segmented and funicle 6-segmented; pedicel and flagellum together not more than two-thirds as long as mesosoma and metasoma combined, usually shorter 182

182(181) Body dorsoventrally flattened; pronotum longitudinally divided; frontovertex with minimum width about two-thirds width of head .... ***Rhopus*** Förster, see 76

– Body not flattened; pronotum not divided; frontovertex with minimum width about one-half width of head 183

183(182) Postmarginal vein at least as long as stigmal vein 184

– Postmarginal vein clearly shorter than stigmal vein 187

184(183) Head in frontal view longer than broad and in lateral view flat with anterior and posterior surfaces almost parallel .... ***Ectromatopsis*** Compere, see 69

– Head in frontal view not longer than broad and in lateral view hemispherical 185

185(184) Scutellum and mesoscutum shiny, with shallow reticulate sculpture .... ***Leptomastix*** Förster, see 160

– Scutellum not shiny and having deeper, minutely rugose or punctate sculpture, contrasting with shiny mesoscutum having shallow, reticulate sculpture 186

186(185) Tegula bright white; head and dorsum of mesosoma dark and metallic .... ***Pseudleptomastix*** Girault, see 82

– Tegula yellow or dusky tan; head and dorsum of mesosoma yellow, orange or white .... ***Gyranusoidea*** Compere, see 73

187(183) Frontovertex and mesoscutum with irregular rugose sculpture (e.g., Figs. 4, 21), appearing silky and not very shiny; scutellum with rugose or shallowly reticulate sculpture not deeper than on mesoscutum (Fig. 21) .... ***Anagyrus*** Howard, see 73

– Frontovertex shiny with regular hexagonal reticulate sculpture (e.g., Fig. 2); mesoscutum shiny, with shallow reticulate sculpture contrasting with deeper, minutely punctate or rugose sculpture of scutellum (Fig. 22) .... ***Apoanagyrus*** Compere, see 84

188(175) Ovipositor either strongly exserted, with exserted part at least one-quarter as long as metasoma, or marginal vein not longer than broad (if ovipositor with exserted part slightly less than one-quarter length of metasoma and marginal vein very slightly longer than broad then sensory part of clava extending much more than one-half its length ventrally, giving clava a very strongly obliquely truncate appearance — some *Copidosoma* spp.) 189

– Ovipositor not or hardly exserted, the exserted part less than one-quarter as long as metasoma; marginal vein clearly longer than broad (if clava strongly obliquely truncate then marginal vein at least 4 times as long as broad) 204

189(188) Ovipositor with exserted part less than one-quarter length of metasoma 190

– Ovipositor with exserted part more than one-quarter length of metasoma 195

190(189) Mouth cavity very wide, at least one-half width of head; forewing apex without marginal fringe .... ***Agromyzaphagus*** Gahan (part)

Fauna: 1 described sp., *A. detrimentosus* Gahan (1912); world, 1 described sp. **Hosts**: Chamaemyiidae.

– Mouth cavity less than one-half width of head; forewing apex with distinct marginal fringe 191

191(190) Torulus separated from mouth margin by less than its own width; stigmal vein with apical sensilla arranged in a square, and without uncus (Fig. 79) .... ***Copidosoma*** Ratzeburg, see 30

– Torulus separated from mouth margin by at least a little more than its own length; stigmal vein with apical sensilla not arranged in a square, and with uncus 192

192(191) Hypopygium not extending more than two-thirds length of metasoma 193

– Hypopygium extending to apex of metasoma 194

193(192) Mesopleuron expanded posteriorly and more or less touching base of metasoma, in lateral view separating propodeum from metacoxa (Fig. 7) .... ***Ooencyrtus*** Ashmead, see 55

– Mesopleuron not touching base of metasoma, in lateral view propodeum touching metacoxa (Fig. 8) .... ***Psyllaephagus*** Ashmead (part)

Fauna: 3 described spp., *P. pachypsyllae* (Howard), *P. trioziphagus* (Howard), and *P. yaseeni* Noyes, and at least 2 undescribed spp.; world, more than 150 described spp. **Hosts**: nymphs of Psyllidae and Triozidae.

194(192) Forewing with punctiform marginal vein; foreleg with apical tarsal segment normal, subequal in size to those of middle and hind legs .... ***Prionomitus*** Mayr (part)

Key: Trjapitzin (1978). **Fauna**: 2 spp., *P. mitratus* (Dalman) and *P. tiliaris* (Dalman) (see Delvare et al. 1981); world, 7 described spp. **Hosts**: nymphs of Psyllidae.

– Forewing without marginal vein (stigmal vein arising from submarginal vein before reaching wing margin) (Fig. 158); foreleg with apical tarsal segment grossly enlarged, distinctly larger than those of middle and hind legs [habitus, Fig. 159] .... ***Sectiliclava*** Hoffer (part)

Fauna: 1 unidentified sp., probably *S. cleone* (Walker); world, 1 described sp. **Hosts**: adult Psyllidae (see Robinson 1961*a* and 1961*b*, as *Parapsyllaephagus adulticollis* Robinson).

195(189) Hypopygium clearly not extending to apex of metasoma 196

– Hypopygium extending to or exceeding apex of metasoma 199

196(195) Ovipositor sheaths compressed and curved slightly downward; tegula (sometimes obscured by mesoscutum) at least partly yellow .... ***Cerchysius*** Westwood (part)

Fauna: 2 described spp., *C. marilandicus* Girault and *C. pallipes* (Provancher); world, 9 described spp. **Hosts**: Chamaemyiidae and Drosophilidae.

– Ovipositor sheaths cylindrical and straight; tegula dark brown 197

197(196) Forewing hyaline .... ***Ooencyrtus*** Ashmead, see 55

– Forewing evenly infuscate 198

198(197) Clava with apex obliquely truncate (Fig. 50); scutellum convex and with reticulate sculpture; head without malar sulcus [forewing, Fig. 51] .... ***Casus*** Noyes & Woolley

Fauna: 1 described sp., *C. parmus* Noyes & Woolley (1994), in Canada (ON) and USA (MO).

– Clava with apex rounded (Fig. 141); scutellum flat and smooth, without sculpture; head with malar sulcus .... **_Pawenus_** Noyes & Woolley, see 174

199(195) Hypopygium extending past apex of last tergum and visible in dorsal view 200

– Hypopygium not extending past apex of last tergum 201

200(199) Postmarginal vein longer than stigmal vein (Fig. 69) .... **_Coccidoctonus_** Crawford (part)

Fauna: 1 described sp., *C. dubius* (Girault); world, 7 described spp. (see Noyes 1988*a* and Timberlake 1919*a*, as *Quaylea whittieri*). **Hosts**: hyperparasites of Coccidae, Pseudococcidae, and Psyllidae, also primary parasites of predatory Drosophilidae.

– Postmarginal vein shorter than stigmal vein (Fig. 96) .... **_Euogus_** Noyes & Woolley, see 180

201(199) Forewing with marginal vein punctiform and not reaching anterior margin, and without postmarginal vein (Fig. 110); head with conspicuous piliferous punctures, each puncture with silvery white seta .... **_Hexacnemus_** Timberlake

Fauna: 1 described sp., *H. armitagei* Timberlake (1926). **Hosts**: Hemerobiidae.

– Forewing with marginal vein reaching anterior margin of wing, and length of marginal and postmarginal veins variable; head without conspicuous piliferous punctures 202

202(201) Occipital margin rounded; stigmal vein with uncus, and sensilla not arranged in a square .... **_Ginsiana_** Erdös & Novicky, see 166

– Occipital margin sharp; stigmal vein without uncus, and sensilla arranged in a square (e.g., Fig. 79) 203

203(202) Scutellum with sculpture forming distinct whorled pattern (Fig. 16); clava with sensory area small, restricted to apex of third segment; marginal vein twice as long as broad, and postmarginal vein subequal in length to stigmal vein .... **_Apsilophrys_** De Santis

Fauna: 3 described spp., *A. armata* (Ashmead), *A. capsica* (Burks), and *A. vaga* (Howard), and additional undescribed spp.; New World only, 4 described spp. **Hosts**: polyembryonic parasites of Gelechiidae.

– Scutellum reticulate, elongate-reticulate or punctate-reticulate, the sculpture never forming whorled pattern; clava with sensory area variable, from small area restricted to apex of apical claval segment to almost entire length of ventral surface of clava; marginal vein less than twice as long as broad, and postmarginal vein variable .... ***Copidosoma*** Ratzeburg, see 30

204(188) Forewing linea calva without filum spinosum (e.g., Figs. 35, 149); hypopygium extending to apex of metasoma 205

– Forewing linea calva with filum spinosum (e.g., Figs. 67, 69, 70, 130, 156) or, if indistinct or absent, hypopygium not extending to apex of metasoma 208

205(204) Postmarginal vein not longer than stigmal vein, its apex at most level with apex of uncus 206

– Postmarginal vein with apex clearly extending past apex of stigmal vein 207

206(205) Scutellum sharply margined posterolaterally, with thin, frequently translucent apical flange overhanging propodeum, and with deep reticulate or rugose sculpture deeper than sculpture of mesoscutum .... ***Ericydnus*** Walker, see 84

– Scutellum with rounded margins posterolaterally, without thin apical flange, and with shallow reticulate sculpture shallower than sculpture of mesoscutum .... ***Clausenia*** Ishii

Key: Kerrich (1967). **Fauna**: 1 described sp., *C. purpurea* Ishii, introduced into USA (CA) to control *Pseudococcus comstocki* (Kuwana), and apparently accidentally introduced into eastern USA with that pest (Cox 1940), and 1 undescribed sp.; world, 11 described spp. **Hosts**: Pseudococcidae.

207(205) Scutellum flat, matt with fine longitudinally striate-reticulate sculpture and posteriorly without raised marginal carina; metasoma at least partly yellow .... ***Charitopus*** Förster

Fauna: at least 1 undetermined sp., possibly *C. fulviventris* Förster; world, 13 described spp. **Hosts**: unknown, but probably parasites of Pseudococcidae associated with grasses.

– Scutellum slightly to strongly convex, quite smooth and shiny and posteriorly with distinct marginal carina apically and laterally; metasoma without yellow areas .... ***Neocharitopus*** Hayat, Alam & Agarwal

Fauna: 2 undescribed spp.; world, 2 described spp. (see Hayat et al. 1975). **Hosts**: Pseudococcidae.

208(204) Mesonotum with mesoscutum and scutellum largely orange or yellow .... ***Neastymachus*** Girault, see 48

– Mesonotum with neither mesoscutum nor scutellum having extensive yellow or orange areas 209

209(208) Torulus with ventral margin at least level with, or only slightly below, ventral margin of eye 210

– Torulus with dorsal margin below or only very slightly above ventral margin of eye 211

210(209) Funicle with segments subequal in size; linea calva interrupted by 1 or 2 setae on dorsal surface (Fig. 102) .... ***Gahaniella*** Timberlake, see 142

– Funicle with apical segments at least about twice as wide as first segment (Fig. 74); linea calva entire, not interrupted (Fig. 75) . ... ***Comones*** Noyes & Woolley, see 54

211(209) Frontovertex with minimum width less than one-quarter width of head; clava with a strong oblique truncation (Fig. 170); eye overreaching rounded occipital margin; funicle with all segments subquadrate or hardly longer than broad .... ***Trjapitzinellus*** Viggiani (part)

Fauna: 1 described sp., *T. microrphanos* Gordh (see Gordh 1973*a*), and at least 1 undescribed sp.; world, 6 described spp. **Hosts**: larvae of Coniopterygidae.

– Frontovertex with minimum width more than one-quarter width of head or, if narrower, either clava apically rounded, or eye not overreaching sharp occipital margin, or funicle with segments more than twice as long as broad 212

212(211) Costal cell with dorsal surface having 1 complete line of setae and numerous scattered setae between this line and submarginal vein (Fig. 148); mandible tridentate; hypopygium extending only about one-half length of metasoma ....***Pseudencyrtus*** Ashmead, see 56

– Costal cell with dorsal surface normally having at most 1 incomplete line of setae, but if with complete line, then with at most 1 or 2 setae between this line and submarginal vein, with mandible having 1 tooth and a truncation, and with hypopygium extending at least two-thirds length of metasoma 213

213(212) Mouth cavity very wide, at least one-half width of head; forewing with sparse short setae and apically without conspicuous marginal fringe; costal cell almost bare dorsally .... ***Agromyzaphagus*** Gahan, see 190

– Mouth cavity much less than one-half width of head; forewing with relatively dense setae and apically with conspicuous marginal fringe; costal cell with incomplete line of setae dorsally 214

214(213) Scutellum strongly convex and with series of ridges in about basal third extending posteriorly from axillae, the apical half smooth and shiny .... ***Lirencyrtus*** Noyes (part)

Fauna: 2 undescribed spp.; world, 1 described sp. (see Noyes 1980). **Hosts**: unknown, but probably larvae of Coleoptera or Diptera.

– Scutellum flat or convex, but sculptured differently 215

215(214) Scutellum with striate-reticulate sculpture of silky appearance (Fig. 18) and with paired pits or glands laterally near middle (visible only in slide-mounted material) .... ***Lamennaisia*** Girault (part)

Fauna: 1 described sp., *L. ambigua* (Nees), and 1 undescribed sp.; world, 4 described spp. [see Noyes (1988*a*)]. **Hosts**: parasites of Bruchidae in seeds of *Vicia* (Fabaceae) and in other regions from phytophagous Eurytomidae (*Bruchophagus roddi* Gussakovsky) in alfalfa, and from larvae of Lathridiidae in corn cobs.

– Scutellum with sculpture different, frequently very shiny, never with paired pits 216

216(215) Legs, including coxae and tarsi (excluding pretarsi) yellow or orange .... ***Helegonatopus*** Perkins, see 55

– Legs marked with black or brown 217

217(216) Marginal vein longer than stigmal vein 218
– Marginal vein not longer than stigmal vein 220

218(217) Antenna with all funicular segments at least twice as long as broad, and first funicular segment as long as pedicel .... ***Psilophryoidea*** Compere, see 174
– Antenna with funicular segments relatively shorter, the sixth segment usually subquadrate and at most 1.5 times as long as broad, and first funicular segment shorter than pedicel 219

219(218) Scutellum with sculpture conspicuously deeper than sculpture of mesoscutum; stigmal vein at most one-half as long as marginal vein (Fig. 65); hypopygium extending about two–thirds length of metasoma .... ***Cheiloneurus*** Westwood, see 41
– Scutellum with sculpture slightly shallower than sculpture of mesoscutum; stigmal vein very nearly as long as marginal vein; hypopygium extending nearly to apex of metasoma .... ***Syrphophagus*** Ashmead, see 173

220(217) Body slightly flattened dorsoventrally; scutellum flat, uniformly polished and highly metallic .... ***Pawenus*** Noyes & Woolley, see 174
– Body robust; scutellum convex, not polished and metallic, normally with deep sculpture, at least in anterior half 221

221(220) Mesopleuron expanded posteriorly and almost touching base of metasoma, in lateral view separating propodeum from metacoxa (Fig. 7) .... ***Ooencyrtus*** Ashmead, see 55
– Mesopleuron not expanded posteriorly and in lateral view not touching base of metasoma, the propodeum touching metacoxa (e.g., Fig. 8) 222

222(221) Marginal vein at least twice as long as broad; clava slender and hardly wider than funicle; mandible tridentate, sometimes with upper tooth transversely truncate .... ***Ginsiana*** Erdös & Novicky, see 166
– Marginal vein punctiform or nearly so or, if about twice as long as broad, either clava very enlarged and about twice as wide as sixth funicular segment or mandible with 1 tooth and a truncation 223

223(222) Clava hardly wider than funicle (even in collapsed specimens clava is at most 1.5 times as wide as sixth funicular segment); mandible with 1 tooth and a broad truncation (Fig. 151) .... ***Psyllaephagus*** Ashmead, see 193

– Clava enlarged, at least about twice as wide as sixth funicular segment (Fig. 162); mandible tridentate .... ***Syrphophagus*** Ashmead, see 173

224(152) Ovipositor with exserted part (measured from apex of last tergum) at least one-quarter length of metasoma 225

– Ovipositor not or hardly exserted, the exserted part less than one-quarter length of metasoma 238

225(224) Hypopygium not extending more than three-fourths length of metasoma 226

– Hypopygium extending to apex of metasoma, or very nearly so 230

226(225) Head with frontovertex having transverse membranous suture between scrobes and anterior ocellus, and usually with pair of longitudinal membranous sutures more or less parallel to eye margin (Fig. 45); clava apically with distinct oblique truncation .... ***Avetianella*** Trjapitzin (part)

Key: Gordh and Trjapitzin (1981). **Fauna**: 3 described spp., *A. buprestidis* Gordh & Trjapitzin, *A. dahlsteni* Trjapitzin, and *A. depressa* (Girault) [see Trjapitzin (1971*a*)]; world, 5 described spp. **Hosts**: parasites of eggs of Buprestidae, Scolytidae, and Cerambycidae.

– Head with frontovertex not having transverse suture; clava apically rounded 227

227(226) Linea calva entire, not interrupted and open near posterior margin of wing (e.g., Figs. 75, 108, 122) 228

– Linea calva interrupted by setae on dorsal surface (e.g., Figs. 102, 138, 156), sometimes closed near posterior margin of wing (e.g., Fig. 35) 229

228(227) Marginal vein punctiform (Fig. 59); frontovertex with deep rugose-punctate sculpture and metallic blue-green; tegula (sometimes obscured by mesoscutum) yellow basally .... ***Cerchysius*** Westwood, see 196

– Marginal vein longer than broad (Fig. 108); frontovertex with shallow reticulate sculpture and black with weak metallic reflections; tegula completely brown .... ***Helygia*** Noyes & Woolley, see 140

229(227) Head and mesosoma black with distinct metallic green sheen; mesoscutum with complete notauli .... ***Saera*** Noyes & Woolley (part)

Fauna: 1 described sp., *S. leuce* Noyes and Woolley (1994), in USA (AZ, TX) and Mexico (Oaxaca), and 1 undescribed spp. **Hosts**: unknown, but probably Coccidae or other Coccoidea.

– Head and mesosoma yellow, orange or brown; mesoscutum without notauli or notauli only in anterior half .... ***Metaphycus*** Mercet, see 39

230(225) Head or mesosoma either yellow, orange or brown and not shiny, or forewing narrow and strap-like; funicle with all segments transverse, occasionally apical segments quadrate but never longer than broad 231

– Head and mesosoma dark and distinctly shiny or metallic; forewing never narrow and strap-like; funicle occasionally with 1 or more segments longer than broad 232

231(230) Mandible bidentate (e.g., Fig. 33) .... ***Cirrhencyrtus*** Timberlake

Fauna: 1 sp., *C. ehrhorni* (Timberlake) (see Timberlake 1916, 1918); world, 2 described spp. **Hosts**: Pseudococcidae.

– Mandible tridentate .... ***Aphycus*** Mayr, see 78

232(230) Forewing with well-marked pattern of hyaline and infuscate areas, and with marginal vein much longer than short stigmal vein; scutellum smooth or nearly so .... ***Tetracnemus*** Westwood, see 60

– Forewing hyaline or weakly infuscate, without pattern of hyaline and infuscate areas, and with marginal vein usually shorter than stigmal vein; scutellum usually with distinct sculpture 233

233(232) Postmarginal vein longer than stigmal vein (Fig. 69) .... ***Coccidoctonus*** Crawford, see 200

– Postmarginal vein not longer than stigmal vein 234

234(233) Body very flattened and leaf-like; forewing weakly infuscate, and parastigma expanded and triangular (Fig. 47) .... ***Boucekiella*** Hoffer, see 115

– Body robust; forewing hyaline or weakly infuscate, and parastigma not distinctly expanded and triangular, although sometimes very weakly so 235

235(234) Scutellum smooth and with sculpture clearly shallower than on mesoscutum; ovipositor with exserted part curved slightly downwards [antenna, Fig. 160; forewing, Fig. 161] .... ***Shenahetia*** Noyes

Fauna: 2 undescribed spp.; world, 1 described sp. (see Noyes 1980). **Hosts**: unknown, but probably larvae of Coleoptera.

– Scutellum with sculpture almost the same as on mesoscutum or deeper; ovipositor with exserted part straight 236

236(235) Stigmal vein subsessile and clearly shorter than marginal vein (Fig. 67); mandible with 1 or 2 teeth and a broad truncation (Fig. 68) .... ***Coccidencyrtus*** Ashmead, see 57

– Stigmal vein not subsessile, and clearly longer than marginal vein; mandible tridentate 237

237(236) Mesoscutum and to a lesser extent frontovertex with well-marked piliferous punctures giving appearance of surface of golf ball or thimble; forewing without marginal vein, the stigmal vein arising directly from submarginal vein (Fig. 52) .... ***Caenocercus*** Thomson

Fauna: 1 sp., *C. planiformis* (Howard); world, 2 described spp. **Hosts**: larvae of Hemerobiidae.

– Mesoscutum and head without well-marked piliferous punctures; forewing with marginal vein, although vein sometimes very short and punctiform (Fig. 79) .... ***Copidosoma*** Ratzeburg, see 30

238(224) Mesosoma with mesoscutum, axillae, or scutellum at least partly yellow, orange or orange-brown 239

– Mesosoma with dorsum completely dark 258

239(238) Forewing infuscate, excluding those species with a very indistinct suffusion of yellow or pale brown or with a very small spot beneath marginal vein which does not or hardly extends past apex of stigmal vein 240

– Forewing hyaline or with very indistinct suffusion of yellow or pale brown, or with a small spot beneath marginal vein which does not or hardly extends past apex of stigmal vein 252

240(239) Funicle with first 2 segments anelliform and hardly visible, third through sixth segments longer than broad; mesotibial spur spatulate (Fig. 9) .... ***Meromyzobia*** Ashmead, see 12

– Funicle with segments different; mesotibial spur cylindrical and pointed at apex 241

241(240) Toruli separated from each other by less than one-half their own length and separated from eyes and mouth margin by at least their own length .... ***Prionomastix*** Mayr

Fauna: 1 sp., *P. biformis* (Ashmead), in USA (AZ, NM); world, 8 described spp. **Hosts**: nymphs of Membracidae.

– Toruli separated from each other by more than one-half their own length and separated from mouth margin or eyes by about their own length or much less 242

242(241) Hypopygium extending to apex of metasoma 243

– Hypopygium not extending more than two-thirds length of metasoma 245

243(242) Funicle with all except sixth segment longer than broad, and first segment about 3 times as long as pedicel (Fig. 38) .... ***Anusioptera*** Brues, see 69

– Funicle with basal 3 segments transverse, with apical 3 segments either quadrate or transverse, and with first segment much shorter than pedicel 244

244(243) Mesoscutum with notauli complete, reaching posterior margin .... ***Homalotyloidea*** Mercet

Fauna: at least 5 unidentified spp.: world, 10 described spp. **Hosts**: larvae of Coccinellidae.

– Mesoscutum without notauli .... ***Aphycus*** Mayr, see 78

245(242) Clava white, contrasting with dark brown funicular segments (Fig. 28) [base of forewing, Fig. 27] .... ***Aesaria*** Noyes & Woolley, see 49

– Clava brown or tan, apical funicular segments frequently yellow or white 246

246(245) Scutellum with reticulate sculpture clearly deeper than sculpture of mesoscutum; mesoscutum sometimes covered with conspicuous silvery setae 247

– Scutellum with sculpture not conspicuously deeper than sculpture of mesoscutum; mesoscutum not covered with conspicuous silvery setae 250

247(246) Forewing conspicuously reduced in size, hardly reaching apex of metasoma and with 1 or 2 triangular hyaline areas .... ***Neococcidencyrtus*** Compere, see 46

– Forewing of normal proportions, if fully developed but hardly reaching apex of metasoma then wing more or less uniformly infuscate, without triangular hyaline areas 248

248(247) Forewing with several distinct triangular or subtriangular hyaline spots .... ***Ruandella*** Risbec (part)

Fauna: 2 undescribed spp.; world, 4 described spp. (see Subba Rao 1972 and Annecke 1971, as *Macchiencyrtus*). **Hosts**: *Ceroplastes* (Coccidae) and Kerriidae.

– Forewing without triangular or subtriangular hyaline spots 249

249(248) Funicle with all segments except last longer than broad; forewing with complete hyaline band across wing beyond venation .... ***Cheiloneurus***, see 41

– Funicle with all segments, except perhaps first, transverse or quadrate; forewing without complete hyaline band beyond venation .... ***Echthrogonatopus*** Perkins, see 48

250(246) Forewing with infuscate area restricted to single diffuse area behind marginal and stigmal veins, the infuscation sometimes nearly reaching posterior margin of wing .... ***Metaphycus*** Mercet, see 39

– Forewing with more extensive infuscation 251

251(250) Forewing uniformly infuscate or with only apex hyaline, without triangular hyaline areas or complete hyaline fasciae beyond venation .... ***Discodes*** Förster, see 169

– Forewing with at least 1 complete hyaline fascia or with triangular hyaline areas beyond venation, and the apex sometimes hyaline .... ***Microterys*** Thomson, see 49

252(239) Clava very large, clearly longer than pedicel and funicle together and nearly twice as broad as sixth funicular segment, apically with strong oblique truncation longer than ventral surface of clava (Fig. 31) .... ***Agarwalencyrtus*** Hayat (part)

Fauna: 1 sp., probably *A. citri* (Agarwal); world, 1 described sp. (see Hayat 1981). **Hosts**: Pseudococcidae and larvae of Pipunculidae.

– Clava normally shorter than funicle although occasionally longer than funicle and pedicel together, but much less than twice as wide as sixth funicular segment and apically rounded or with relatively weakly oblique truncation 253

253(252) Body dorsoventrally flattened; pronotum longitudinally divided and normally hidden by head at this point; head usually with 1 conspicuous, long seta between posterior ocellus and eye .... ***Rhopus*** Förster, see 76

– Body robust; pronotum undivided and with at least posterior margin visible behind head; head with frontovertex sometimes having long setae, but never with a conspicuous single erect seta between posterior ocellus and eye 254

254(253) Hypopygium extending to apex of metasoma; head with deep scrobes and dorsal part of interantennal prominence acute and sharply margined (Fig. 19) .... ***Mucrencyrtus*** Noyes, see 65

– Hypopygium not extending more than about five-sixths length of metasoma; head with interantennal prominence dorsally rounded and not sharply margined 255

255(254) Marginal vein punctiform or nearly so; linea calva only rarely entire, almost always interrupted by setae on dorsal surface; mesosoma usually yellow or brown, but if metallic then only weakly so ... . ***Metaphycus*** Mercet, see 39

– Marginal vein at least twice as long as broad; linea calva entire; mesosoma dorsally at least partly metallic 256

256(255) Frontovertex and eyes covered with conspicuous long dark setae, the setae on frontovertex at least about twice as long as diameter of an ocellus and setae on eye longer than diameter of a facet; mandible with 2 teeth, the lower tooth very short, almost absent, giving mandible a sickle-shaped appearance (Fig. 153) .... ***Rhytidothorax*** Ashmead (part)

Fauna: 2 described spp., *R. marlatti* Ashmead and *R. niveiclava* (Girault), and at least 5 undescribed spp.; world, 7 described spp. (see Trjapitzin and Gordh 1979*c*). **Hosts**: unknown, but probably larvae of Diptera or Coleoptera feeding on decomposing vegetation.

– Frontovertex with setae not especially conspicuous, the setae about as long as diameter of an ocellus, and eye with setae about as long as diameter of a facet; mandible tridentate 257

257(256) Ovipositor slightly but distinctly curved upwards, not exserted; mesoscutum mostly orange, anteriorly brown .... ***Protyndarichoides*** Noyes

Fauna: 2 unidentified spp.; world, 3 described spp. (see Noyes 1980). **Hosts**: unknown, but in France associated with Scolytidae on *Pinus*.

– Ovipositor straight and slightly exserted; mesoscutum mostly or entirely metallic green or blue .... ***Cheiloneurus*** Westwood, see 41

258(238) Funicle with first segment longer than broad 259

– Funicle with first segment not longer than broad 308

259(258) Marginal vein punctiform or absent (e.g., Figs. 122, 144) 260

– Marginal vein longer than broad (e.g., Figs. 58, 102) 270

260(259) Forewing with apex of venation having a bare, hyaline streak connecting postmarginal and stigmal veins (Fig. 144) [antenna, Fig. 142] .... ***Pentelicus*** Howard, see 122

– Forewing with apex of venation not having bare, hyaline streak 261

261(260) Torulus separated from mouth margin by more than its own length; hind wing at least about 4 times as long as broad; frontovertex without deep piliferous punctures [forewing base, Fig. 122] .... ***Ixodiphagus*** Howard (part)

Fauna: 2 spp., *I. texanus* Howard and *I. hookeri* (Howard) (see Quaraishi 1958); world, 6 described spp. **Hosts**: Ixodidae; *I. hookeri* unsuccessfully used in attempts to control disease-carrying ticks in USA (Clausen 1978).

– Torulus separated from mouth margin by not more than its own length or, if so, hind wings not more than 3 times as long as broad and frontovertex with deep piliferous punctures 262

262(261) Clava 1- to 3-segmented and apically with strong, oblique truncation at least as long as ventral surface of clava 263

– Clava always 3-segmented, occasionally with very slight oblique truncation, but truncation always much shorter than ventral surface of clava 264

263(262) Clava 3-segmented and at least about 3 times as broad as first funicular segment; frontovertex and mesosoma dorsally usually with conspicuous piliferous punctures similar in appearance to surface of thimble or golf ball .... ***Bothriothorax*** Ratzeburg

Fauna: 8 described and at least 4 unidentified spp.; world, 30 described spp. **Hosts**: larvae of Syrphidae and Lonchaeidae.

– Clava 1-segmented or, if 3-segmented, clava not more than about twice as broad as first funicular segment; frontovertex and mesosoma dorsally without conspicuous piliferous punctures .. .. ***Copidosoma*** Mayr, see 30

264(263) Linea calva interrupted by setae on dorsal surface 265

– Linea calva entire, although occasionally closed near posterior margin of wing 266

265(264) Head with pattern of pale and dark areas on face, interantennal prominence sharp dorsally (e.g., Fig. 19), and scrobes deep grooves; ovipositor not or hardly exserted .... ***Tachardiobius*** Timberlake

Fauna: 1 sp., *T. nigricans* Timberlake (1926); world, 2 described spp. **Hosts**: *Tachardiella larreae* (Comstock) (Kerriidae).

– Head with unicolorous face, interantennal prominence rounded dorsally, and scrobes not deep grooves; ovipositor slightly exserted, the exserted part about as long as mesotibial spur ....***Saera*** Noyes & Woolley, see 229

266(264) Mesopleuron enlarged posteriorly and nearly touching base of metasoma, in lateral view clearly separating propodeum from metacoxa (Fig. 7) ....***Ooencyrtus*** Ashmead, see 55

– Mesopleuron well separated from base of metasoma, in lateral view propodeum touching metacoxa (Fig. 8) 267

267(266) Hypopygium not extending more than about three-quarters length of metasoma 268

– Hypopygium extending to apex of metasoma 269

268(267) Mandible with 3 acute teeth; clava more than three-quarters as long as funicle ....***Pseudencyrtus*** Ashmead, see 56

– Mandible with 1 or 2 teeth and a truncation (Fig. 151); clava not more than one-half as long as funicle ....***Psyllaephagus*** Ashmead, see 193

269(267) Forewing without marginal vein, the stigmal vein arising from apex of submarginal vein (Fig. 158); foreleg with apical tarsal segment grossly enlarged; hypopygium barely extending to apex of metasoma .... ***Sectiliclava*** Hoffer, see 194

– Forewing with marginal vein; foreleg with apical tarsal segment more or less same size as apical segments of middle and hind legs; hypopygium extending a little beyond apex of last tergum ....***Prionomitus*** Mayr, see 194

270(259) Forewing infuscate, excluding those species with a very indistinct suffusion of yellow or pale brown or with a very small spot beneath marginal vein which does not or hardly extends past apex of stigmal vein 271

– Forewing hyaline with a very indistinct suffusion of yellow or pale brown, or with a small spot beneath marginal vein which does not or hardly extends past apex of stigmal vein 283

271(270) Torulus with ventral margin above ventral margin of eye; clava 1-segmented .... ***Carabunia*** Waterston

Fauna: 1 sp., *C. myersi* Waterston, in USA (FL); world, 7 described spp. (see Subba Rao 1973). **Hosts**: nymphs of Cercopidae.

– Torulus with ventral margin below ventral margin of eye; clava 3-segmented 272

272(271) Forewing with distinct pattern of hyaline spots or infuscate fasciae beyond venation 273

– Forewing with infuscate areas rather diffuse and not well delimited 279

273(272) Head with line of conspicuous silvery setae across face between top of scrobes and eyes; clava as long as funicle, or nearly so .... ***Epitetracnemus*** Girault, see 116

– Head without line of silvery setae across face; clava clearly shorter than funicle, not longer than combined length of segments 3–6 274

274(273) Clava asymmetric, with ventral surface flat and upper surface strongly curved (Fig. 128); occipital margin rounded .... ***Mayridia*** Mercet, see 20

– Clava more or less symmetrical, occasionally with apex slightly obliquely truncate ventrally; occipital margin often sharp 275

275(274) Head with scrobes deep and sharply delimited, and interantennal prominence elongate, tapered to acute point, and sharply margined dorsally (e.g., Fig. 19) .... ***Aloencyrtus*** Prinsloo, see 168

– Head with scrobes relatively shallow and not sharply delimited, and interantennal prominence rounded dorsally 276

276(275) Forewing with at least 2 well defined triangular or subtriangular hyaline areas beyond venation, the hyaline areas sometimes narrowly connected (Fig. 105) 277

– Forewing with 1 or 2 hyaline bands beyond venation 278

277(276) Maxillary palpus with apical segment very conspicuous (even on card-mounted specimens), enlarged and dark brown, a little longer than combined length of other palpal segments and clearly much broader; scutellum convex, with posterior third polished; forewing disc covered with dense, scale-like setae; stigmal vein almost perpendicular to anterior margin of wing .... ***Ruandella*** Risbec, see 248

– Maxillary palpus with apical segment not enlarged, shorter than combined length of other segments and not significantly broader; scutellum flat with only extreme apex smooth and shiny; forewing disc covered with normal setae; stigmal vein forming strongly acute angle with anterior margin of wing .... ***Habrolepopteryx*** Ashmead

Fauna: 1 described sp., *H. pulchripennis* (Ashmead) (see Gordh and Trjapitzin 1981), and possibly additional undescribed spp. in USA (FL, TX); Nearctic only. **Hosts**: unknown, but associated with grasses, including marsh grass (*Spartina*).

278(276) Forewing with 1 strongly curved hyaline band beyond venation, the apical margin of hyaline band subparallel with apical margin of wing for much of its length .... ***Trichomasthus*** Thomson, see 51

– Forewing either with more than 1 hyaline band beyond venation (occasionally second band represented by 2 spots on opposite sides of wing) or with 1 very nearly straight hyaline band having its apical margin not subparallel with apical margin of wing for much of its length .... ***Microterys*** Thomson, see 49

279(272) Stigmal vein very short, less than one-third length of marginal vein, its apex connected to apex of postmarginal vein by a bare hyaline streak; forewing strongly and evenly infuscate, the infuscation extending from base of marginal vein more or less to apex of wing .... ***Cheiloneurus*** Westwood, see 41

– Stigmal vein at least one-half as long as marginal vein, without hyaline streak at apex of venation; forewing not evenly infuscate from marginal vein to apex 280

280 (279) Venation yellowish; forewing with a triangular or wedge-shaped infuscate mark extending from of level apex of venation to apex of wing 281

– Venation brown; forewing with infuscation diffuse and different from above 282

281(280) Forewing with submarginal vein conspicuously swollen and broadly triangular in apical third (Fig. 125); scutellum flat; occipital margin rounded .... ***Mahencyrtus*** Masi, see 57

– Forewing with submarginal vein not swollen in apical third (Fig. 163); scutellum convex; occipital margin convex .... ***Syrphophagus*** Ashmead, see 173

282(281) Flagellum brown, unicolorous; hypopygium with a long, narrow, finger-like median projection extending to apex of metasoma.. .... ***Centencyrtus*** Noyes & Woolley (part)

Fauna: 1 described sp., *C. anser* Noyes & Woolley (1994), in USA (TX); Nearctic only.

– Flagellum with black and white segments; hypopygium triangular or shield-shaped and without finger-like median projection .... ***Apoanagyrus*** Compere, see 84

283(270) Stigmal vein apically truncate, without uncus, and with sensilla arranged in compact square (Fig. 79); torulus separated from mouth margin by less than its own length; clava 1- or 3-segmented; occipital margin sharp .... ***Copidosoma*** Ratzeburg, see 30

– Stigmal vein with uncus, and sensilla not arranged in compact square; torulus sometimes separated from mouth margin by more than its own length; clava 3-segmented; occipital margin sometimes rounded 284

284(283) Hypopygium extending to apex of metasoma or very nearly so; cerci sometimes in apical third of metasoma 285

– Hypopygium not extending more than about three-quarters length of metasoma; cerci in basal half of metasoma or very nearly so 295

285(284) Scutellum convex, with basal third having several conspicuous ridges extending posteriorly from axillae and apical half smooth and shiny .... ***Lirencyrtus*** Noyes, see 214

– Scutellum flat or slightly convex, without basal ridges and apical half smooth or with distinct sculpture 286

286(285) Scutellum smooth, almost mirror-like, without sculpture or with barely discernible sculpture much shallower than on mesoscutum 287

– Scutellum with sculpture similar in appearance to sculpture of mesoscutum or deeper 291

287(286) Mesopleuron orange, contrasting with metallic green mesoscutum and scutellum 288

– Mesopleuron, mesoscutum, and scutellum more or less concolorous 289

288(287) Hypopygium with long, narrow, finger-like median projection extending to apex of metasoma .... ***Centencyrtus*** Noyes & Woolley, see 282

– Hypopygium broadly triangular or shield-shaped, without finger-like projection .... ***Tachinaephagus*** Ashmead (part)
Key: Subba Rao (1978). **Fauna**: 1 described sp., *T. zealandicus* Ashmead, and 1 undescribed sp.; world, 10 described spp. **Hosts**: synanthropic Diptera; *T. zealandicus* is used to control flies associated with poultry and dairy farms (Greathead 1986).

289(287) Head flattened, more or less prognathous .... ***Zaommoencyrtus*** Girault, see 18

– Head not flattened, hypognathous 290

290(289) Forewing with filum spinosum converging strongly toward basal margin of linea calva (Fig. 58); mandible tridentate, occasionally upper tooth very short, giving mandible a bidentate appearance .... ***Cerchysiella*** Girault, see 148

– Forewing with filum spinosum not clearly converging toward basal margin of linea calva (e.g., Fig. 52); mandible bidentate, but lower tooth very short, giving mandible a long and sickle-shaped appearance (Fig. 153) .... ***Rhytidothorax*** Ashmead, see 256

291(286) Flagellum with black and white segments .... ***Apoanagyrus*** Compere, see 84

– Flagellum unicolorous brown or black 292

292(291) Head in frontal view with frontovertex narrower than eye or, if broader, cerci at midpoint or in basal half of metasoma 293

– Head in frontal view with frontovertex wider than eye; cerci near apex of metasoma or in apical third 294

293(292) Frontovertex with minimum width less than one-quarter width of head; mandible tridentate .... ***Trjapitzinellus*** Viggiani, see 211

– Frontovertex with minimum width greater than one-quarter width of head; mandible bidentate, lower tooth very short, giving mandible a long and sickle-shaped appearance (Fig. 153) .... ***Rhytidothorax*** Ashmead, see 256

294(292) Linea calva interrupted by setae on dorsal surface (Fig. 138); metasoma with apical tergum having anterior margin convex and cerci on posterior margin of tergum (Fig. 135); mandible with 1 tooth and a truncation [antenna, Fig. 136] .... ***Oesol*** Noyes & Woolley

Fauna: 1 described sp., *O. anubis* Noyes & Woolley (1994), in USA (AZ, CA, TX), and 1 undescribed sp.; Nearctic only. **Hosts**: Kermesidae.

– Linea calva entire (Fig. 41); metasoma with apical tergum having anterior margin concave (emarginate) and cerci on anterior margin of tergum; mandible tridentate .... ***Aphycoides*** Mercet (part)

Fauna: 1 described sp., *A. clavellatus* (Dalman); world, 8 described spp. **Hosts**: *Physokermes* and other Coccidae.

295(284) Funicle with first segment at least as long as pedicel and pedicel not more than 1.5 times as long as broad 296

– Funicle with first segment distinctly shorter than pedicel or, if about as long or slightly longer, pedicel at least twice as long as broad 298

296(295) Mouth cavity very wide, wider than frontovertex and at least one-half width of head .... ***Hemencyrtus*** Ashmead

Fauna: 1 undescribed sp.; world, 1 described sp. (see Noyes 1980). **Hosts**: unknown, but probably larvae of Coleoptera.

– Mouth cavity not wider than frontovertex and not more than about one-third width of head 297

297(296) Mandible tridentate; linea calva entire .... ***Perpolia*** Noyes & Woolley

Fauna: 1 described sp., *P. trebia* Noyes & Woolley (1994), in USA (AZ, TX), and possibly 2 more spp.; Nearctic only.

– Mandible with 1 or 2 teeth and a broad truncation (e.g., Fig. 147); linea calva interrupted by 1 line of setae on dorsal surface .... ***Gahaniella*** Timberlake, see 142

298(295) Clava with oblique truncation, at least apical claval suture oblique (Fig. 63) .... ***Cheiloneurus*** Westwood, see 41

– Clava apically rounded, both claval sutures more or less parallel ... .299

299(298) Either forewing more than 3 times as long as broad, or mesopleuron enlarged and touching base of metasoma and in lateral view clearly separating propodeum from metacoxa (Fig. 7) 300

– Forewing less than 3 times as long as broad; mesopleuron not touching base of metasoma, in lateral view propodeum more or less touching metacoxa (Fig. 8) 303

300(299) Scutellum convex; torulus with dorsal margin at least a little below ventral margin of eye 301

– Scutellum flat; torulus with dorsal margin above ventral margin of eye 302

301(300) Propodeum with sides near spiracle having conspicuous silvery setae; body longer than 1.5 mm .... ***Trichomasthus*** Thomson, see 51

– Propodeum with sides near spiracle having inconspicuous brown setae; body shorter than 1.25 mm .... ***Ooencyrtus*** Ashmead, see 55

302(300) Metasoma with anterior part as wide as or wider than propodeum; propodeum with posterolateral angles touching base of metasoma; submarginal vein without conspicuously enlarged parastigma (Fig. 75) .... ***Comones*** Noyes & Woolley, see 54

– Metasoma with anterior part narrower than propodeum; propodeum with posterolateral angles not touching metasoma; submarginal vein with parastigma thickened, broadly triangular (Fig. 125) .... ***Mahencyrtus*** Masi, see 57

303(299) Frontovertex and eyes covered with conspicuous setae, the setae on frontovertex dark and at least as long as diameter of an ocellus, and the setae on eye dark or translucent, each seta longer than diameter of a facet 304

Frontovertex covered with inconspicuous pale or translucent setae, and eye covered with short setae and appearing more or less bare 305

304(303) Mandible broad, tridentate; hypopygium not or hardly extending one-half length of metasoma .... ***Exoristobia*** Ashmead, see 141

– Mandible very slender, unidentate or, if bidentate, lower tooth very short, almost non-existent (Fig. 153); hypopygium usually extending at least two-thirds length of metasoma, sometimes nearly to apex .... ***Rhytidothorax*** Ashmead, see 256

305(303) Mandible with 1 or 2 teeth and a broad truncation (e.g., Fig. 151); tegula frequently yellow or pale orange basally; marginal vein at most about as long as stigmal vein, never distinctly longer 306

– Mandible tridentate; tegula unicolorous brown, occasionally dark orange basally; marginal vein at least about as long as stigmal vein, frequently more than twice as long 307

306(305) Marginal vein only about one-half as long as stigmal vein and only very slightly longer than broad .... ***Psyllaephagus*** Ashmead, see 193

– Marginal vein about as long as stigmal vein and clearly longer than broad .... ***Blastothrix*** Mayr, see 132

307(305) Forewing with dorsal surface of costal cell having at least 1 line of setae extending nearly to base and 2 lines of setae in apical half (Fig. 148) .... ***Pseudencyrtus*** Ashmead, see 56

– Forewing with dorsal surface of costal cell having only 1 line of setae, the line not reaching more than about half way to base of wing (Fig. 163) .... ***Syrphophagus*** Ashmead, see 173

308(258) Face with series of membranous lines between toruli and anterior ocellus (Figs. 45, 95) 309

– Face without membranous lines 311

309(308) Stigmal vein distinctly longer than marginal vein (Fig. 94); mouth cavity broad, in frontal view about one-half width of head (Fig. 95) .... ***Eucoccidophagus*** Hoffer

Fauna: 1 unidentified sp.; world, 5 described spp. **Hosts**: Eriococcidae and Pseudococcidae.

– Stigmal vein not longer than marginal vein; mouth cavity in frontal view at most one-third width of head (Fig. 45) 310

310(309) Clava 1-segmented .... ***Szelenyiola*** Trjapitzin

Fauna: 1 described sp., *S. nearctica* Trjapitzin (1977); world, 2 described spp. **Hosts**: eggs of Buprestidae and Scolytidae.

– Clava 3-segmented ....***Avetianella*** Trjapitzin, see 226

311(308) Hypopygium extending to apex of metasoma 312

– Hypopygium extending at most four-fifths length of metasoma 334

312(311) Clava at least as long as funicle (Figs. 25, 71, 73) or, if very slightly shorter, mesosoma dorsally very convex and matt with very fine longitudinally striate or strigose sculpture 313

– Clava not longer than apical 5 funicular segments together; mesosoma dorsally sometimes distinctly convex, but never matt with very fine longitudinally striate or strigose sculpture 320

313(312) Mesoscutum and scutellum strongly convex and matt with longitudinally elongate, almost finely striate sculpture (Fig. 17) .... ***Parablatticida*** Girault (part)

Fauna: 3 unidentified spp.; world, 7 described spp. **Hosts**: unknown, but possibly larvae of Diptera.

– Mesoscutum and scutellum not strongly convex, frequently metallic but if matt then sculpture not finely striate 314

314(313) Submarginal vein with strong subapical expansion (Fig. 70) .... ***Coccidoxenoides*** Girault

Fauna/Hosts: 1 described sp., *C. peregrinus* (Timberlake) (see Timberlake 1919*a*, as *Pauridia* — used to control Pseudococcidae in orchards and greenhouses); world, 2 described spp.

– Submarginal vein without subapical expansion 315

315(314) Costal cell with dorsal surface having at least 1 complete line of setae (e.g., Fig. 148); head and dorsum of mesosoma almost always with conspicuous piliferous punctures similar in appearance to surface of golf ball or thimble; forewing with postmarginal and stigmal veins relatively long, and stigmal vein conspicuously curved 316

– Costal cell with dorsal surface bare (Fig. 113) or with at most 1 line of setae extending half way toward base of wing (e.g., Fig. 149); head and dorsum of mesosoma without thimble-like piliferous punctures; forewing with postmarginal and stigmal veins relatively short, and stigmal vein never strongly curved 318

316(315) Forewing with postmarginal vein distinctly longer than stigmal vein, and without hyaline streak connecting the veins .... ***Blepyrus*** Howard

Fauna: 6 described and 2 or 3 undescribed spp.; world, 12 described spp. (see Kerrich 1967, including *Euryrhopalus* Howard). **Hosts**: Pseudococcidae.

– Forewing with postmarginal vein not or hardly longer than stigmal vein, and occasionally with bare hyaline streak connecting the veins 317

317(316) Forewing with postmarginal and stigmal veins not connected at apex by bare hyaline streak; head and dorsum of mesosoma smooth, without deep thimble-like punctures .... ***Zarhopalus*** Ashmead, see 113

– Forewing with postmarginal and stigmal veins connected at apex by bare hyaline streak; head and dorsum of mesosoma with deep thimble-like piliferous punctures .... ***Aenasius*** Walker, see 113

318(315) Forewing infuscate (Fig. 113) .... ***Holcencyrtus*** Ashmead, see 63

– Forewing hyaline 319

319(318) Clava 3-segmented and at least 1.5 times as wide as sixth funicular segment (Fig. 73); head with mouth one-half width of head and occipital margin rounded; stigmal vein with uncus .... ***Coelopencyrtus*** Timberlake, see 147

– Clava 1-segmented and subequal in width to sixth funicular segment; head with mouth less than one-half width of head and occipital margin sharp; stigmal vein truncate and without uncus (Fig.79) .... ***Copidosoma*** Ratzeburg, see 30

320(312) Body strongly dorsoventrally flattened, either leaf-like or pronotum longitudinally divided 321
– Body robust; pronotum undivided 322

321(320) Body leaf-like; eyes with inner margins converging ventrally; pronotum undivided .... ***Platencyrtus*** Ferrière
Fauna/Hosts: 1 described sp., *P. parkeri* Ferrière (1955), released into USA (TX) to control *Antonina graminis* (Maskell) (Pseudococcidae); world, 1 described sp.
– Body not leaf-like; eyes with inner margins subparallel; pronotum longitudinally divided .... ***Rhopus*** Förster, see 76

322(320) Metasoma with cerci in apical third .... ***Aphycoides*** Mercet, see 294
– Metasoma with cerci in basal two-thirds (CAUTION: if metasoma grossly distended or inflated, cerci may appear to be in apical third of metasoma) 323

323(322) Marginal vein punctiform or absent 324
– Marginal vein longer than broad 328

324(323) Ventral margin of torulus level with or above ventral margin of eye and separated from mouth margin by more than its own length .... ***Ixodiphagus*** Howard, see 261
– Ventral margin of torulus below eye, separated from mouth margin by much less than its own length 325

325(324) Forewing with perpendicular hyaline streak at apex of venation (Fig. 144) .... ***Pentelicus*** Howard, see 122
– Forewing without perpendicular hyaline streak at apex of venation 326

326(325) Stigmal vein apically truncate, without uncus, and with sensilla arranged symmetrically in a square (e.g., Fig. 79) .... ***Copidosoma*** Ratzeburg, see 30

– Stigmal vein apically with uncus, and sensilla not arranged in a square 327

327(326) Foreleg with apical tarsal segment grossly enlarged, clearly larger than those of middle and hind legs; mesoscutum without lateral indentations; marginal vein more or less absent, the stigmal vein arising directly from submarginal vein (Fig. 158) .... ***Sectiliclava*** Hoffer, see 194

– Foreleg with apical tarsal segment subequal in size to those of middle and hind legs; mesoscutum with indentation on each side adjacent to each tegula (Fig. 10); marginal vein present .... ***Prionomitus*** Mayr, see 194

328(323) Head in frontal view with frontovertex narrower than eye; clava with outer suture strongly oblique (Fig. 170) .... ***Trjapitzinellus*** Viggiani, see 211

– Head in frontal view with frontovertex wider than eye; clava with sutures parallel or nearly so 329

329(328) Scutellum mostly smooth and shiny, without any sculpture 330

– Scutellum clearly sculptured, hardly shiny 332

330(329) Mesoscutum smooth, without sculpture; mesothoracic spiracle protuberant, raised above surface of pronotum and mesoscutum and clearly visible; ovipositor not exserted, the sheaths very short, reduced to papilla-like structures at most about one-fifteenth as long as ovipositor; hypopygium medially covered with dense long setae .... ***Tachinaephagus*** Ashmead, see 288

– Mesoscutum conspicuously sculptured; mesothoracic spiracle not raised above surface of pronotum; ovipositor at least slightly exserted, the sheaths long and distinct, at least one-sixth length of ovipositor; hypopygium with setae short and inconspicuous 331

331(330) Ovipositor sheaths exserted for about one-quarter length of metasoma, the exserted part almost as long as mesotibial spur and slightly downcurved .... ***Tanyencyrtus*** De Santis

Fauna: 1 unidentified sp. in USA (FL); world, 1 described sp. (see De Santis 1972). **Hosts**: larvae of fruit-mining Lepidoptera.

– Ovipositor sheaths not exserted or exserted less than one-fifth length of metasoma, the visible part not downcurved .... ***Cerchysiella*** Girault, see 148

332(329) Clypeal margin slightly produced as median lobe, distinctly rounded medially; costal cell with dorsal surface having 3 or 4 lines of setae in apical half (Fig. 130); propodeum with carinae medially [antenna, Fig. 129] .... ***Merlen*** Noyes & Woolley

Fauna: 1 described sp., *M. agricola* Noyes & Woolley (1994), in Canada (ON, PQ) and USA (AZ); Nearctic only.

– Clypeal margin not produced medially, shallowly emarginate; costal cell with dorsal surface having only 1 line of setae in apical half; propodeum without carinae medially 333

333(332) Stigmal vein subsessile, not longer than marginal vein (Fig. 67); mandible with 1 or 2 teeth and a truncation (Fig. 68) .... ***Coccidencyrtus*** Ashmead, see 57

– Stigmal vein clearly longer than marginal vein; mandible tridentate .... ***Metaphycus*** Mercet, see 39

334(311) Head with eye very nearly touching base of mandible, the malar space less than one-fifth length of eye .... ***Parablastothrix*** Mercet, see 170

– Head with malar space at least one-third length of eye 335

335(334) Clava strongly obliquely truncate, the truncate part at least as long as remaining part of ventral surface of clava (Figs. 31, 89), and clava either 1-segmented (Fig. 78) or segmented with very oblique sutures 336

– Clava usually apically rounded or at most with slightly oblique apical truncation much shorter than remaining ventral surface of clava and sutures not or hardly oblique, but if (rarely) truncate part as long as or longer than remaining ventral surface of clava and sutures slightly oblique (some *Forcipestricis*) then scutellum with tubercles or pits (Figs. 13, 14) 340

336(335) Mesoscutum covered with conspicuous silvery setae; forewing infuscate with pair of triangular hyaline areas beyond venation, the infuscation sometimes faint in apical half and wing appearing hyaline .... ***Echthrogonatopus*** Perkins, see 48

– Mesoscutum with setae dark or translucent; forewing not infuscate, although weakly infumate with darker area behind marginal vein not extending past apex of stigmal vein 337

337(336) Mesosoma dorsally dark brown or black, and with silky striate-reticulate sculpture .... ***Agarwalencyrtus*** Hayat, see 252

– Mesosoma dorsally metallic green or blue, at least in part, and without striate sculpture except sometimes on scutellum 338

338(337) Submarginal vein with triangular subapical expansion (Fig. 172)... .... ***Tyndarichus*** Howard, see 137

– Submarginal vein without triangular subapical expansion 339

339(338) Clava 3-segmented (Fig. 89); marginal vein at least 4 times as long as broad; stigmal vein with uncus, and sensilla at apex not arranged in compact symmetrical group .... ***Epiencyrtus*** Ashmead

Fauna: 3 described spp., *E. artaceae* (Howard), *E. thyreodontis* (Ashmead) (see Trjapitzin and Gordh 1980*b*), and *E. turni* (Packard); world, 3 described spp. **Hosts**: hyperparasites, apparently polyembryonic, of larvae of Sphingidae and Lasiocampidae through Ichneumonidae.

– Clava 1-segmented (Fig. 78); marginal vein not more than 3 times as long as broad; stigmal vein without uncus, and sensilla at apex arranged in symmetrical, compact square (Fig. 79) .... ***Copidosoma*** Ratzeburg, see 30

340(335) Either marginal vein punctiform with venation ∨–shaped beyond hyaline break in submarginal vein (e.g., Figs. 122, 144) or mesopleuron enlarged posteriorly and touching base of metasoma or nearly so 341

– Marginal vein longer than broad, venation Y–shaped beyond hyaline break (e.g., Figs. 58, 102); mesopleuron not enlarged posteriorly, separated from metasoma by metapleuron and propodeum 345

341(340) Linea calva interrupted by setae on dorsal surface 342

– Linea calva entire 343

342(341) Mesosoma dorsally and head strongly metallic green; stigmal vein without uncus and with sensilla at apex arranged symmetrically in compact square (e.g., Fig. 79) .... ***Paralitomastix*** Mercet

Fauna: 1 described sp., *P. pyralidis* (Ashmead) (see Ashmead 1888); world, 16 described spp. **Hosts**: polyembryonic parasites of larvae of Gelechiidae and Pyralidae.

– Mesosoma dorsally matt, occasionally shiny, but never strongly metallic green; stigmal vein with uncus, and sensilla at apex not arranged symmetrically in compact group .... ***Metaphycus*** Mercet, see 39

343(341) Mesopleuron enlarged posteriorly and more or less touching base of metasoma (Fig. 7) .... ***Ooencyrtus*** Ashmead, see 55

– Mesopleuron separated from base of metasoma by metapleuron and propodeum, in lateral view metapleuron and propodeum more or less reaching metacoxa (Fig. 8) 344

344(343) Clava conspicuously enlarged and twice as wide as sixth funicular segment or very nearly so (e.g., Fig. 162); mandible tridentate .... ***Syrphophagus*** Ashmead, see 173

– Clava about as wide as sixth funicular segment; mandible with 1 tooth and a broad truncation (Fig. 151) .... ***Psyllaephagus*** Ashmead, see 193

345(340) Head with mouth cavity very wide, conspicuously more than one-half width of head, and with frontovertex more than one-half width of head .... ***Zaommoencyrtus*** Girault, see 18

– Head with mouth cavity and frontovertex both less than one-half width of head 346

346(345) Postmarginal vein at least 1.5 times as long as stigmal vein .... ***Ageniaspis*** Dahlbom, see 135

– Postmarginal vein not longer than stigmal vein or hardly so 347

347(346) Occipital margin sharp, acute; forewing with linea calva not interrupted by setae (e.g., Figs. 75, 108, 122) 348

– Occipital margin rounded or, if acute, forewing with linea calva interrupted by setae on dorsal surface (e.g., Figs. 102, 138, 156) 353

348(347) Frontovertex and mesoscutum dark brown or black, sometimes shiny but without any metallic sheen 349

– Frontovertex and/or mesoscutum with at least slight metallic sheen 351

349(348) Hypopygium more or less extending to apex of metasoma; mesoscutum matt with striate-reticulate sculpture (Fig. 17) or, if shiny with shallow sculpture, hypopygium extending to or beyond apex of last tergum .... ***Parablatticida*** Girault, see 313

– Hypopygium extending at most about two-thirds length of metasoma; mesoscutum shiny with relatively shallow sculpture, the sculpture not striate-reticulate 350

350(349) Scutellum with tubercles or pits (Figs. 13, 14); frontovertex frequently very smooth, without sculpture; stigmal vein more or less straight, not forming a smooth curve toward margin of wing and conspicuously widest subapically (Fig. 99) .... ***Forcipestricis*** Burks

Fauna: 1 described sp., *F. gazeaui* Burks (1968), and 2 undescribed spp.; world, 2 described spp. **Hosts**: larvae of Ceratopogonidae.

– Scutellum without tubercles or pits; frontovertex always clearly sculptured; stigmal vein characteristic, almost of uniform width throughout and with its anterior margin forming a smooth curve to tip of uncus, the uncus separated from anterior margin of wing by only slightly more than its own maximum width (Fig. 100) .... ***Exoristobia*** Ashmead, see 141

351(348) Scutellum with longitudinally striate sculpture (Fig.18) .... ***Lamennaisia*** Girault, see 215

– Scutellum without striate sculpture 352

352(351) Mandible with 1 or 2 teeth and a very broad truncation; flagellum usually with apical funicular segments paler than basal segments, sometimes clava darkest of all .... ***Metablastothrix*** Sugonjaev

Key: Sugonjaev and Trjapitzin (1988). **Fauna**: 1 described sp., *M. claripennis* (Compere), and 1 undescribed sp.; world, 2 described spp. **Hosts**: hyperparasites of Coccidae through Encyrtidae (Sugonjaev 1984).

– Mandible tridentate, sometimes with 1 (upper) tooth truncate; flagellum usually unicolorous dark brown .... ***Syrphophagus*** Ashmead, see 173

353(347) Linea calva interrupted by setae on dorsal surface or broadly closed posteriorly 354
– Linea calva entire 356

354(353) Mandible with 1 tooth or 2 teeth and a truncation (Fig. 68); stigmal vein subsessile, not longer than marginal vein (e.g., Fig. 67) .... ***Coccidencyrtus*** Ashmead, see 57
– Mandible with 3 teeth; stigmal vein relatively long and clearly longer than marginal vein 355

355(354) Clava 1- or 2-segmented .... ***Saera*** Noyes & Woolley, see 229
– Clava 3-segmented .... ***Metaphycus*** Mercet, see 39

356(353) Clava as long as funicle 357
– Clava shorter than funicle 360

357(356) Head with line of silvery setae across face above scrobes and below eyes; forewing strongly infuscate with 4 triangular, hyaline areas beyond venation (Fig. 91) .... ***Epitetracnemus*** Girault, see 116
– Head without line of silvery setae across face; forewing hyaline or, if infuscate, with no more than 2 triangular hyaline areas beyond venation 358

358(357) Scutellum convex, occasionally with sculpture deeper than sculpture of mesoscutum; mandible tridentate .... ***Syrphophagus*** Ashmead, see 173
– Scutellum flat, with deep reticulate sculpture much deeper than sculpture of mesoscutum; mandible with 2 teeth and a truncation or with 4 teeth 359

359(358) Funicle with at least some apical segments yellow or white and contrasting with dark brown clava; mesoscutum almost always with a few conspicuous silvery setae; mandible with 3 teeth or 2 teeth and a truncation .... ***Zaomma*** Ashmead, see 91

– Flagellum unicolorous yellowish or occasionally clava slightly darker yellow; mesoscutum never with conspicuous silvery setae; mandible with 4 teeth .... ***Adelencyrtus*** Ashmead

Key: Compere and Annecke (1961). **Fauna**: 3 described spp., *A. aulacaspidis* (Brèthes), *A. moderatus* (Howard), and *A. odonaspidis* Fullaway; world, 25 described spp. **Hosts**: Diaspididae.

360(356) Mandible with 1 tooth and a broad truncation (Fig. 151) .... ***Psyllaephagus*** Ashmead, see 193

– Mandible with 3 acute teeth 361

361(360) Forewing not or hardly more than 2.5 times as long as broad; parastigma not noticeably swollen; occiput with shallow groove extending from occipital foramen to occipital margin (Fig. 6).. .... ***Achalcerinys*** Girault

Fauna/Hosts: 1 described sp., probably *A. triclavata* Girault, in other regions reared from Pseudococcidae, possibly hyperparasitic through other Encyrtidae; world, 4 described spp.

– Forewing at least nearly 3 times as long as broad; parastigma conspicuously swollen, almost triangular (Fig. 125); occiput without groove .... ***Mahencyrtus*** Masi, see 57

Males (for key to females see p. 175; annotations for genera are indicated by female couplet number)

1 Flagellum branched (e.g., Fig. 167) 2

– Flagellum not branched 9

2(1) Funicle 5-segmented .... ***Tetracnemoidea*** Howard, see ♀ 28

– Funicle 6-segmented (e.g., Fig. 167) 3

3(2) Funicle with at least 5 segments branched 4

– Funicle with at most 4 segments branched 6

4(3) Torulus higher than ventral margin of eye and much nearer anterior ocellus than mouth margin...... ***Hexacladia*** Ashmead, see ♀ 32

– Torulus with at least the ventral margin much lower than ventral margin of eye and nearer mouth margin than anterior ocellus 5

5(4) Flagellum with 5 segments branched .... ***Copidosoma*** Ratzeburg, see ♀ 30

– Flagellum with 6 segments branched .... ***Hexacnemus*** Timberlake, see ♀ 201

6(3) Funicle with first 4 segments branched .... ***Parablastothrix*** Mercet, see ♀ 170

– Funicle with segments 2–5 branched 7

7(6) Stigmal vein very short, not more than about one-half length of marginal vein .... ***Tetracnemus*** Westwood, see ♀ 60

– Stigmal vein at least as long as marginal vein 8

8(7) Notauli conspicuous and complete, more or less extending to posterior margin of mesoscutum; scutellum flat and without carina laterally or posteriorly .... ***Charitopus*** Förster, see ♀ 207

– Notauli not conspicuous, and only in anterior half of mesoscutum; scutellum convex and with carina along its lateral and posterior margins .... ***Neocharitopus*** Hayat, Alam & Agarwal, see ♀ 207

9(1) Flagellum with fewer than 6 visible funicular segments 10

– Flagellum with at least 6 clearly visible funicular segments 29

10(9) Clava long and sausage-shaped, at least 4 times as long as broad; funicular segments transverse (Figs. 23, 90) 11

– Clava not long and sausage-shaped, normally not more than 3 times as long as broad, but if longer then at least 4 funicular segments longer than broad 16

11(10) Clava with whorls of elongate setae, the setae longer than diameter of segment; forewing with marginal, postmarginal, and stigmal veins poorly delimited and indistinct (Fig. 43) .... ***Arrhenophagus*** Aurivillius, see ♀ 2

– Clava without whorls of long setae, the setae much shorter than diameter of segments; forewing with apical parts of venation distinct 12

12(11) Postmarginal vein much longer than stigmal vein, which is clearly longer than marginal vein; funicle with more than 2 segments, but majority of segments obscured by base of clava (Fig. 23) .... ***Aenasius*** Walker, see ♀ 113

– Postmarginal vein not or hardly longer than stigmal vein, which is short and not longer than marginal vein; funicle with only 2 clearly visible, anelliform segments (Fig. 90) 13

13(12) Mesofemur entirely yellow (occasionally a little dusky in apical half) or linea calva interrupted by 1 or 2 setae on dorsal surface 14

– Mesofemur entirely or mostly dark brown; linea calva not interrupted 15

14(13) Linea calva not interrupted (e.g., Figs. 75, 108, 122); metatibia yellow or only narrowly brown or black .... ***Adelencyrtus*** Ashmead, see ♀ 359

– Linea calva almost always interrupted dorsally (e.g., Figs. 102, 138, 156); metatibia mostly dark brown or black .... ***Habrolepis*** Förster, see ♀ 87

15(13) Clava longer than width of head .... ***Epitetracnemus*** Girault, see ♀ 116

– Clava shorter than width of head .... ***Plagiomerus*** Crawford, see ♀ 8

16(10) Forewing fully developed and postmarginal vein much longer than stigmal vein 17

– Forewing not fully developed or, if so, postmarginal vein not longer than stigmal vein 18

17(16) Clava longer than funicle; funicle with all segments anelliform and without longitudinal sensilla .... ***Blepyrus*** Howard, see ♀ 316

– Clava shorter than funicle; funicle with all segments transverse, but not anelliform, and with longitudinal sensilla .... ***Hambletonia*** Compere, see ♀ 111

18(16) Mesotibial spur spatulate, with apex more or less rounded (Fig. 9); funicle with 4 segments longer than broad, occasionally with a fifth very small, anelliform segment basally; forewing, if fully developed, conspicuously infuscate .... ***Meromyzobia*** Ashmead, see ♀ 12

– Mesotibial spur normal, slender and apically pointed; if funicle as above then wings fully developed and hyaline or very weakly infuscate 19

19(18) Head and mesosoma completely dark brown and shiny with metallic green sheen; metasoma completely dark brown 20
– Head and mesosoma partly yellow or brown, not shiny or metallic green or, if so, metasoma at least partly yellow 23

20(19) Funicle 4-segmented .... ***Cercobelus*** Walker, see ♀ 7
– Funicle 5-segmented 21

21(20) Eye small, shorter than malar space .... ***Zaommoencyrtus***, see ♀ 18
– Eye normal, longer than malar space 22

22(21) Funicle with all segments clearly longer than broad .... ***Helegonatopus*** Perkins, see ♀ 55
– Funicle with at least some segments quadrate or transverse .... ***Trechnites*** Thomson, see ♀ 26

23(19) Clava shorter than funicle; linea calva interrupted by setae on dorsal surface; notauli present in anterior part of mesoscutum, although very indistinct; flagellum unicolorous pale brown .... ***Pseudorhopus*** Timberlake, see ♀ 20
– Clava not shorter than funicle or, if so, linea calva entire; notauli absent; clava sometimes yellow, contrasting with brown funicle 24

24(23) Head and mesosoma dark brown and moderately shiny, metasoma distinctly paler, at least basally; pronotum not paler than mesoscutum .... ***Bothriocraera*** Timberlake, see ♀ 27
– Head and mesosoma varying from dusky white or yellow to brown, but if dark brown and shiny then pronotum paler than mesoscutum 25

25(24) Scutellum with apical margin straight for almost its entire width .... ***Stemmatosteres*** Timberlake, see ♀ 13
– Scutellum with apical margin more or less rounded 26

26(25) Funicle with first 2 segments subequal and anelliform and each at most about half size of third segment (e.g., Fig. 32) .... ***Ameromyzobia***, see ♀ 23

– Funicle with segments gradually increasing in size apically, the first 2 segments not contrasting in size with third segment 27

27(26) Maxillary palpus 2-segmented; labial palpus 1-segmented .... ***Pseudectroma*** Girault, see ♀ 19

– Maxillary palpus 3- or 4-segmented; labial palpus 2-segmented 28

28(27) Antenna unicolorous, yellow or testaceous; pronotum and mesoscutum more or less unicolorous ....***Acerophagus*** Smith, see ♀ 14

– Antenna with clava white or pale yellowish, paler than darker funicular segments (funicular segments usually dark brown, but occasionally yellow); pronotum frequently whitish and distinctly paler than mesoscutum .... ***Pseudaphycus*** Clausen, see ♀ 14

29(9) Interantennal prominence strongly produced between toruli as angular projection (Fig. 20) .... ***Paratetracnemoidea*** Girault, see ♀ 151

– Interantennal prominence with lower part not produced 30

30(29) Flagellum with longest setae at most as long as greatest diameter of corresponding segment (Figs. 30, 137, 140, 150, 164) 31

– Flagellum with longest setae longer than diameter of corresponding segment (Figs. 34, 46, 62, 143) 88

31(30) Clava with distinct oblique apical truncation (e.g., Figs. 117, 121) and forewing fully developed 32

– Clava more or less rounded apically or forewing reduced and not extending to apex of metasoma 39

32(31) Notauli present and extending at least about half way across mesoscutum 33

– Notauli absent..36

33(32) Occipital margin rounded, not carinate; funicle with segments quadrate or longer than broad.......... ***Saera*** Noyes & Woolley, see ♀ 229

– Occipital margin sharp, carinate; funicle with at least some segments transverse 34

34(33) Notauli extending about half way across mesoscutum .... **Isodromus** Howard, see ♀ 150

– Notauli extending to posterior margin of mesoscutum or nearly so 35

35(34) Eye with posterior margin slightly concave, appearing kidney-shaped; stigmal vein forming acute angle of about 30° with anterior margin of wing (Fig. 118) .... **Homalotylus** Mayr, see ♀ 150

– Eye with posterior margin straight or convex; stigmal vein forming angle of about 60° with anterior margin of wing (Fig. 116) .... **Homalotyloidea** Mercet, see ♀ 244

36(32) Forewing infuscate with extreme apex hyaline and with a curved hyaline fascia beyond venation .... **Comperia** Gomes, see ♀ 112

– Forewing more or less completely hyaline 37

37(36) Frontovertex and dorsum of mesosoma with conspicuous piliferous punctures giving appearance of surface of golf ball or thimble .... **Bothriothorax** Ratzeburg, see ♀ 263

– Frontovertex and dorsum of mesosoma without conspicuous piliferous punctures 38

38(37) Dorsal margin of torulus level with ventral margin of eye .... **Mayridia** Mercet, see ♀ 20

– Dorsal margin of torulus below ventral margin of eye .... **Copidosoma** Ratzeburg, see ♀ 30

39(31) Interantennal prominence sharp dorsally (e.g., Fig. 19) 40

– Interantennal prominence rounded dorsally 41

40(39) Head unicolorous orange or brown .... **Mucrencyrtus** Noyes, see ♀ 65

– Head with pattern of paler and darker areas clearly visible in frontal view .... **Tachardiobius** Timberlake, see ♀ 265

41(39) Forewing fully developed, with postmarginal vein about as long as stigmal vein, and tegula at least partly yellow or orange and contrasting with metallic green mesoscutum and scutellum .... ***Microterys*** Thomson, see ♀ 49

– Not with above combination of characters: if forewing fully developed and postmarginal vein about as long as stigmal vein then either tegula brown or mesoscutum and scutellum dull and not metallic green 42

42(41) Forewing reduced, either strap-like or not extending more than half way along metasoma 43

– Forewing fully developed, extending beyond apex of metasoma 50

43(42) Scape strongly flattened and broad, leaf-like, less than 2.5 times as long as broad 44

– Scape not flattened and leaf-like, at least 3 times as long as broad 45

44(43) Body bright red; eye more or less circular, hardly longer than broad; flagellum with dark and pale segments .... ***Metaphycus*** Mercet, see ♀ 39

– Body orange with slight metallic sheen especially on mesoscutum; eye distinctly oval, nearly twice as long as broad; flagellum unicolorous dark brown ...... ***Formicencyrtus*** Girault, see ♀ 68

45(43) Wing rudiments opaque white .... ***Baeocharis*** Mayr, see ♀ 44

– Wing rudiments hyaline or infuscate, not opaque white 46

46(45) Tegula uniformly brown or orange-brown 47

– Tegula white or yellow basally, with apex brown or translucent greyish 49

47(46) Mandible with 1 or 2 teeth and a broad truncation (Fig. 123); torulus separated from mouth margin by at least its own length .... ***Ixodiphagus*** Howard, see ♀ 261

– Mandible with 3 teeth; torul[illegible] separated from mouth margin by much less than its own length 48

48(47) Pronotum in dorsal view about two-thirds length of mesoscutum; torulus virtually touching mouth margin, its dorsal margin well below ventral margin of eye [♂ antenna, Fig. 82] .... ***Ebito*** Noyes & Woolley, see ♀ 78

– Pronotum in dorsal view less than one-half length of mesoscutum; torulus separated from mouth margin by at least nearly one-half its own length, its dorsal margin level with or only a little below ventral margin of eye .... ***Metaphycus*** Mercet, see ♀ 39

49(46) Funicle with all segments longer than broad; mesopleuron posteriorly enlarged and touching base of metasoma, in lateral view mesopleuron separating propodeum from metacoxa (Fig. 7) .... ***Ooencyrtus*** Ashmead, see ♀ 55

– Funicle with at least first 4 segments transverse (Fig. 42); mesopleuron not touching base of metasoma, in lateral view propodeum touching metacoxa (e.g., Fig. 8) .... ***Aphycus*** Mayr, see ♀ 78

50(42) Postmarginal vein at least slightly longer than stigmal vein (Fig. 133) 51

– Postmarginal vein not longer than stigmal vein 63

51(50) Mesoscutum and scutellum black (without any orange or yellow areas), with very fine, longitudinally striate or striate-reticulate sculpture giving silky appearance; scutellum strongly convex; frontovertex mostly with distinct blue or green sheen contrasting with color of mesoscutum and scutellum; mandible tridentate .... ***Ageniaspis*** Dahlbom, see ♀ 135

– Not as above: either mesoscutum and scutellum with orange or yellow areas, or these not having very fine longitudinally striate sculpture, or scutellum not strongly convex, or head and mesosoma concolorous; mandible frequently without teeth or with only 2 teeth 52

52(51) Funicle with all segments longer than broad, the first sometimes only slightly so 53

– Funicle not with all segments longer than broad, with at least 1 or 2 segments transverse or quadrate 58

53(52) Scutellum with distinct apical tuft of setae (Fig. 88) .... ***Encyrtus*** Latreille, see ♀ 64
– Scutellum without apical tuft of setae 54

54(53) Torulus with ventral margin clearly above ventral margin of eye; mandible never with 2 or 3 apical teeth 55
– Torulus with ventral margin well below ventral margin of eye; mandible with 2 or 3 acute teeth 56

55(54) Toruli separated from each other by at least about two-thirds their own length; mandible with 1 long sickle-shaped tooth (Fig. 53); forewing with distinct infuscate pattern .... ***Carabunia*** Waterston, see ♀ 271
– Toruli very nearly touching each other; mandible with 1 tooth and broad straight truncation, the truncate part with a series of minute denticles along its edge (Fig. 146); forewing more or less hyaline .... ***Prionomastix*** Mayr, see ♀ 241

56(54) Funicle with first segment clearly shorter than remaining segments .... ***Clausenia*** Ishii, see ♀ 206
– Funicle with first segment at least as long as one of the apical funicle segments, normally at least a little longer than apical segments 57

57(56) Funicle filiform, the segments attached to each other medially (Fig. 92) .... ***Ericydnus*** Walker, see ♀ 84
– Funicle appearing serrate, the segments attached to each other ventrally (Fig. 132) .... ***Mira*** Schellenberg, see ♀ 59

58(52) Head in frontal view with eye not longer than width of frontovertex 59
– Head in frontal view with eye longer than width of frontovertex 61

59(58) Funicle with first segment slightly longer than broad .... ***Aschitus*** Mercet, see ♀ 40
– Funicle with all segments transverse 60

60(59) Eye shorter than malar space; head and mesosoma orange to orange-brown, with hardly any metallic green sheen ....***Extencyrtus*** Noyes & Woolley, see ♀ 101
– Eye longer than malar space; head and mesosoma metallic green (sometimes dull), never orange or orange-brown .... ***Holcencyrtus*** Ashmead, see ♀ 63

61(58) Width of frontovertex less than one-quarter width of head .... ***Blepyrus*** Howard, see ♀ 316
– Width of frontovertex at least about one-third width of head 62

62(61) Funicle with segments strongly transverse, none longer than pedicel ....***Zarhopalus*** Ashmead, see ♀ 113
– Funicle with at least some segments subquadrate and at least about twice as long as pedicel .... ***Chrysoplatycerus*** Ashmead, see ♀ 102

63(50) Scutellum shiny, without sculpture; forewing with filum spinosum converging toward basal margin of linea calva (Fig. 58) .... ***Cerchysiella*** Girault, see ♀ 148
– Scutellum with distinct sculpture, often somewhat matt; forewing with filum spinosum parallel to basal margin of linea calva or in a rounded or oval group and not converging with basal margin of linea calva 64

64(63) Stigmal vein without recognizable uncus and apical sensilla arranged in compact symmetrical group (e.g., Fig. 79) 65
– Stigmal vein with recognizable uncus (e.g., Figs. 70, 138, 156) and apical sensilla not arranged in compact symmetrical group 68

65(64) Scutellum with striate-reticulate (e.g., Fig. 18) or whorled sculpture (e.g., Fig. 16) contrasting with sculpture of mesoscutum 66
– Scutellum with reticulate sculpture more or less similar to that of mesoscutum 67

66(65) Scutellum with whorled sculpture (Fig. 16); genitalia with digiti extremely long and projecting well past the reduced and rounded parameres, and with phallobase having only 3 pairs of long setae near apex of each paramere .... ***Apsilophrys*** De Santis, see ♀ 203

– Scutellum striate-reticulate; genitalia with digiti, if exposed, barely extending past the pointed parameres, and with phallobase and parameres having several pairs of setae .... ***Paralitomastix*** Mercet, see ♀ 342

67(65) Propodeal spiracle round or broadly oval, clearly separated from anterior margin of propodeum (Fig. 12) .... ***Copidosoma*** Mayr, see ♀ 30

– Propodeal spiracle comma- or pear-shaped with narrow part extending to anterior margin of propodeum (Fig. 11) .... ***Copidosomopsis*** Girault, see ♀ 30

68(64) Funicle with all segments longer than broad 69

– Funicle not with all segments longer than broad 74

69(68) Flagellum 8-segmented 70

– Flagellum 7-segmented 71

70(69) Flagellum with funicle 7-segmented and clava 1-segmented (Fig. 164); torulus with ventral margin at least level with ventral margin of eye; body longer than 1.5 mm .... ***Tachinaephagus*** Ashmead, see ♀ 288

– Flagellum with funicle 6-segmented and clava 2-segmented (Fig. 137); torulus with dorsal margin about level with ventral margin of eye; body shorter than 1.0 mm .... ***Oesol*** Noyes & Woolley, see ♀ 294

71(69) Antenna with pedicel as long as first funicular segment or nearly so .... ***Pawenus*** Noyes & Woolley, see ♀ 174

– Antenna with pedicel not more than half as long as first funicular segment 72

72(71) Forewing weakly infuscate; mandible with 3 acute teeth; marginal vein at least about 3 times as long as broad .... ***Mayridia*** Mercet, see ♀ 20

– Forewing hyaline; mandible with at least 1 tooth truncate or broadly rounded; marginal vein varying from punctiform to about 3 times as long as broad 73

73(72) Head in frontal view with frontovertex not wider than length of eye or, if so, funicular segments conspicuously broadened and at least about 1.5 times as wide as pedicel (Fig. 150); torulus frequently with ventral margin below ventral margin of eye .... ***Psyllaephagus*** Ashmead, see ♀ 193

– Head in frontal view with frontovertex wider than length of eye; funicle with segments not broadened and at most only slightly broader than pedicel; torulus with ventral margin level with or above ventral margin of eye .... ***Ginsiana*** Erdős & Novicky, see ♀ 166

74(68) Metasoma with cerci virtually at apex and apical tergum clearly shorter than second tergum [♂ antenna, Fig. 40] .... ***Aphycoides*** Mercet, see ♀ 294

– Metasoma with cerci in at least basal two-thirds and apical tergum (measured from cerci to apex) longer than any other 75

75(74) Notauli absent; head and mesosoma dark brown or metallic; forewing hyaline; linea calva entire 76

– Not with above combination of characters: either notauli present, or head and mesosoma with distinct orange or yellow areas, or forewing partly infuscate, or linea calva interrupted 81

76(75) Clava 2-segmented (Fig. 30) .... ***Agarwalencyrtus*** Hayat, see ♀ 252

– Clava 1-segmented (on card-mounted specimens occasionally appearing to have 2 segments due to arrangement of the longitudinal sensilla, see Fig. 140) 77

77(76) Funicle with at least some segments as long or longer than pedicel (Fig. 140) 78

– Funicle with all segments shorter than pedicel 79

78(77) Mesoscutum and scutellum distinctly convex, with striate-reticulate sculpture (Fig. 17), and appearing matt .... ***Parablatticida*** Girault, see ♀ 313

– Mesoscutum and scutellum with more or less coriaceous, shallow sculpture (Fig. 15) and appearing at least slightly lustrous; mesoscutum and scutellum sometimes convex .... ***Ooencyrtus*** Ashmead, see ♀ 55

79(77) Submarginal vein with apical third wide, broadly triangular and conspicuous (Fig. 70); longitudinal sensilla on all flagellar segments conspicuous and each about as long as a funicular segment (Fig. 72); mandible with 2 sharp teeth .... ***Coccidoxenoides*** Girault, see ♀ 314

– Submarginal vein with apical third not conspicuously widened; longitudinal sensilla on flagellar segments not conspicuous, shorter than any funicular segment; mandible not with 2 sharp teeth 80

80(79) Marginal vein punctiform; mandible with 1 tooth and a broad truncation (Fig. 123) .... ***Ixodiphagus*** Howard, see ♀ 261

– Marginal vein clearly longer than broad; mandible tridentate .... ***Coelopencyrtus*** Timberlake, see ♀ 147

81(75) Eye small, only about two-thirds as long as minimum width of frontovertex; scape less than 3 times as long as broad; mandible bidentate .... ***Neodusmetia*** Kerrich, see ♀ 75

– Eye larger, at least three-quarters as long as minimum width of frontovertex and normally longer than width of frontovertex; scape often more than 3 times as long as broad; mandible normally not bidentate 82

82(81) Notauli complete and more or less meeting in middle of posterior margin of mesoscutum; linea calva not interrupted or closed posteriorly .... ***Homalotyloidea*** Mercet, see ♀ 244

– Notauli absent or extending at most about half way across mesoscutum, but if present and complete then linea calva interrupted dorsally or closed posteriorly 83

83(82) Body dorsoventrally flattened; scrobes delimited dorsally by transverse groove or ridge which is nearly as wide as mouth; eye about as long as minimum width of frontovertex; body completely yellow; notauli present anteriorly .... ***Mariola*** Noyes, see ♀ 123

– Body robust; scrobes rounded dorsally; either eye at least a little longer than minimum width of frontovertex or body largely dark brown; notauli frequently completely absent 84

84(83) Clava either longitudinally asymmetric, with one margin more or less straight and the other curved especially in its apical half, or with a short oblique apical truncation (Fig. 42); notauli absent or indicated at extreme anterior margin of mesoscutum only 85

– Clava longitudinally symmetric, apically rounded or, if as above, notauli present and extending half way across mesoscutum 86

85(84) Mandible bidentate .... ***Cirrhencyrtus*** Timberlake, see ♀ 231

– Mandible tridentate .... ***Aphycus*** Mayr, see ♀ 78

86(84) Mandible with 1 tooth and a broad truncation; clava dusky white, contrasting with dark brown funicular segments; scape at least 3 times as long as broad (Fig. 155) .... ***Sarisencyrtus*** Noyes & Woolley, see ♀ 146

– Mandible tridentate; clava normally concolorous with funicle, but if paler then scape usually less than 3 times as long as broad 87

87(86) Head and mesosoma metallic green (sometimes dull); linea calva not interrupted dorsally .... ***Perpolia*** Noyes & Woolley, see ♀ 297

– Head and mesosoma matt, and yellow, orange, dark brown or black, never metallic green; linea calva usually interrupted .... ***Metaphycus*** Mercet, see ♀ 39

88(30) Mandible with 2 teeth that are more or less equal in length (e.g., Fig. 33); sixth funicular segment or clava almost always with ventral, perpendicular scale-like sensilla (e.g., Fig. 34) 89

– Mandible with 3 teeth [occasionally third (upper) tooth very short (*Cerchysiella*)], or 1 or 2 teeth and a truncation, or, if mandible bidentate, then teeth very unequal in length; flagellum never with scale-like sensilla 101

89(88) Notauli present and extending at least half way across mesoscutum 90

– Notauli absent 91

90(89) Short winged .... ***Dusmetia*** Mercet, see ♀ 71

– Fully winged .... ***Dicarnosis*** Mercet, see ♀ 95

91(89) Frontovertex with sculpture irregular, not forming distinct closed polygonal cells 92

Frontovertex between anterior ocellus and antennal scrobes with sculpture consisting of closed, sometimes very regular, polygonal cells 95

92(91) Pronotum longitudinally divided and normally not visible medially behind head; body conspicuously flattened .... ***Rhopus*** Förster, see ♀ 76

– Pronotum entire and normally visible medially behind head; body sometimes flattened but not strongly so 93

93(92) Flagellum with very short setae only about one-fifth as long as diameter of segments; funicle with apical segments having longitudinal sensilla longer than half length of segment; winged specimen with venation not extending more than two-fifths along wing .... ***Anomalicornia*** Mercet, see ♀ 72

– Flagellum with setae generally at least 1.5 times as long as diameter of segments, rarely shorter; funicle with longitudinal sensilla shorter than half length of segments; winged specimen with venation extending at least half way along wing 94

94(93) Head and mesosoma metallic green; mesoscutum covered with conspicuous silvery setae; propodeum very setose, with a continuous line of setae extending to middle (difficult to see in card-mounted specimens, but very distinct in cleared, slide-mounted specimens) .... ***Epanusia*** Girault, see ♀ 60

– Head and mesosoma yellow to dark brown, never metallic; mesoscutum rarely covered with conspicuous silvery setae; propodeal setae not extending to middle (some extralimital species have a single pair of setae in middle third) .... ***Anagyrus*** Howard, see ♀ 73

95(91) Postmarginal vein not longer than stigmal vein, normally distinctly shorter; tegula completely dark brown or black or, occasionally, with apex paler 96

– Postmarginal vein longer than stigmal vein or, if about as long as or slightly longer than stigmal vein, tegula with basal half white or yellowish and apex dark brown, or entirely translucent greyish 97

96(95) Scape completely black or dark brown; femora dark brown .... ***Apoanagyrus*** Compere, see ♀ 84 .... and ***Ectromatopsis*** Compere, see ♀ 69

– Scape paler at its apex or some femora yellowish .... ***Apoanagyrus*** Compere, see ♀ 84

97(95) Forewing with 2 more or less complete, transverse fuscous fasciae (Fig. 124) .... ***Leptomastidea*** Mercet, see ♀ 162

– Forewing hyaline or, if infuscate, with at most 1 indistinct fascia 98

98(97) Either linea calva entire and open or propodeum long medially, at least one-quarter as long as scutellum and, except for a small central area, covered throughout with dense white setae; clava and sixth funicular segment frequently without perpendicular scale-like setae .... ***Anusioptera*** Brues, see ♀ 69

– Linea calva interrupted or closed by at least a single line of setae on dorsal surface; propodeum not covered with dense white setae or, if so, propodeum medially less than one-sixth as long as scutellum; clava or sixth funicular segment almost always with perpendicular scale-like sensilla 99

99(98) Head (except across occiput) and mesosoma (except mesothoracic venter, axillae, anterior part of mesoscutum, and metanotum) mostly orange .... ***Leptomastix*** Förster, see ♀ 160

– Head mostly, and mesosoma at least dorsally, dark brown or black with metallic green sheen 100

100(99) Frontovertex with reticulate sculpture of rather regular mesh that is more or less equal in size to an eye facet (Fig. 1); head and mesosoma frequently with yellow or orange areas .... ***Gyranusoidea*** Compere, see ♀ 73

– Frontovertex with reticulate sculpture of irregular mesh that is generally larger than an eye facet (Fig. 3); head and mesosoma, except tegulae and appendages, completely black or dark brown with a metallic green sheen .... **Pseudleptomastix** Girault, see ♀ 82

101(88) Head with membranous lines (e.g., Fig. 45) 102
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105(104) Scutellum with apical tuft of setae (Fig. 64) or wing remnants infuscate .... **Cheiloneurus** Westwood, see ♀ 41
– Scutellum without apical tuft of setae; wing remnants hyaline [♂ antenna, Fig. 85] .... **Ectroma** Westwood, see ♀ 53

106(104) Head and mesosoma without strong metallic sheen; body, including legs, mostly brown; submarginal vein not expanded in apical one-quarter .... **Pseudencyrtus** Ashmead, see ♀ 56
– Head and mesosoma strongly metallic blue, green and purple; fore and middle legs usually yellow, but if profemur and mesofemur brown except at base and apex and protibia brown at apex then submarginal vein expanded in apical one-quarter (Fig. 55) .... **Cerapterocerus** Westwood, see ♀ 37

107(103) Mandible slender, with 1 long, sickle-shaped tooth (e.g., Fig. 153) .... **Rhytidothorax** Ashmead, see ♀ 256
– Mandible different 108

108(107) Postmarginal vein longer than stigmal vein 109
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109(108) Scutellum with recognizable apical tuft of setae (e.g., Fig. 88); mandible broadly truncate or apically rounded, without teeth .... ***Encyrtus*** Latreille, see ♀ 64

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110(109) Legs except coxae completely yellow, or base of tegula yellow contrasting with darker or translucent apex 111

– Legs except coxae at least partly dark brown or black; tegula completely brown or, occasionally, very slightly paler basally but never yellow 114

111(110) Mesoscutum with sculpture on anterolateral areas slightly elongate and contrasting with the more polygonal sculpture at center; legs except coxae completely yellow, though sometimes knees and pretarsi slightly marked with dark brown; tegula sometimes completely brown 112

– Mesoscutum more or less uniformly sculptured; legs usually extensively marked with dark brown; tegula always with basal half or so yellow 113

112(111) Mesocoxa entirely yellow .... ***Diversinervus*** Silvestri, see ♀ 38

– Mesocoxa partly brown .... ***Prochiloneurus*** Silvestri, see ♀ 90

113(111) Head and mesosoma with fine, punctate-reticulate sculpture, and metallic but not very shiny; flagellum with very long setae at least about 3 times as long as diameter of corresponding segment (Fig. 46) .... ***Blastothrix*** Mayr, see ♀ 132

– At least mesoscutum with shallow coriaceous sculpture and very shiny; flagellum with setae only slightly longer than diameter of corresponding segment .... ***Microterys*** Thomson, see ♀ 49

114(110) Mesoscutum with translucent or silvery setae in posterior half or so, contrasting with darker setae of anterior portion ....
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115(114) Postmarginal vein less than 1.5 times as long as stigmal vein 116

– Postmarginal vein more than 1.5 times as long as stigmal vein 118

116(115) Mesoscutum and scutellum more or less concolorous, blackish with hardly a metallic (bluish) sheen; flagellum with setae less than twice as long as diameter of corresponding segment .... ***Deilio*** Noyes & Woolley, see ♀ 118

– Mesoscutum with distinct greenish or brassy sheen contrasting with purplish or greenish-purple scutellum; flagellum with setae at least twice as long as diameter of corresponding segment (but setae sometimes appearing relatively shorter in specimen where segments have collapsed during drying) 117

117(116) Mandible with 1 tooth and a broad truncation; funicle with setae only slightly longer than twice diameter of corresponding segment .... ***Metablastothrix*** Sugonjaev, see ♀ 352

– Mandible with 3 teeth; funicle with setae nearly 3 times as long as diameter of corresponding segment .... ***Atropates*** Howard, see ♀ 111

118(115) Scutellum finely reticulate except apex smooth and distinctly metallic .... ***Coccidoctonus*** Crawford, see ♀ 200

– Scutellum striate-reticulate and appearing silky or matt, the apex clearly sculptured, not smooth and metallic 119

119(118) Mesoscutum shining metallic green, contrasting with the matt or silky appearing scutellum .... ***Paraleurocerus*** Girault, see ♀ 135

– Mesoscutum and scutellum appearing similarly matt or silky 120

120(119) Linea calva interrupted dorsally; funicle with first segment shorter than any of the 3 apical segments .... ***Ageniaspis*** Dahlbom, see ♀ 135

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121(108) Marginal vein punctiform (e.g., Figs. 122, 144) and stigmal vein always distinct 122
– Marginal vein longer than broad (e.g., Figs. 58, 102) and stigmal vein sometimes subsessile or indistinct 132

122(121) Head and mesosoma, except legs and tegulae, partly orange or yellow .... ***Metaphycus*** Mercet, see ♀ 39
– Head and mesosoma completely dark, metallic blue or green, dark brown or black 123

123(122) Forewing without setae along apical margin .... ***Agromyzaphagus*** Gahan, see ♀ 190
– Forewing with setae along apical margin 124

124(123) Tegula with basal half yellow; mesopleuron clearly separated from base of metasoma by propodeum and metapleuron, in lateral view the propodeum and metapleuron touching metacoxa (e.g., Fig. 8) 125
– Tegula completely brown, sometimes very slightly paler basally, but if yellow basally then mesopleuron posteriorly enlarged and touching base of metasoma, in lateral view mesopleuron separating metapleuron and propodeum from metacoxa (e.g., Fig. 7) 126

125(124) Forewing without marginal vein, the stigmal vein arising from submarginal vein before it reaches anterior margin of wing (Fig. 158); occipital margin sharp and carinate .... ***Sectiliclava*** Hoffer, see ♀ 194
– Forewing with marginal vein (Fig. 59); occipital margin not sharp .... ***Cerchysius*** Westwood, see ♀ 196

126(124) Mesoscutum laterally with very strong indentation or fovea immediately above prepectus and anterior to tegula (Fig. 10) .... ***Prionomitus*** Mayr, see ♀ 194
– Mesoscutum without fovea laterally 127

127(126) Either head or dorsum of mesosoma with deep piliferous punctures similar in appearance to surface of golf ball or thimble or, if punctures shallow, scutellum with very slight median longitudinal keel or ridge along most of its length (e.g., Fig. 145) 128

– Head and mesosoma without deep piliferous punctures; scutellum without longitudinal keel or ridge 129

128(127) Mesosoma strongly metallic green or blue; postmarginal vein less than half as long as stigmal vein; scutellum without any discernible median keel or ridge .... ***Bothriothorax*** Ratzeburg, see ♀ 263

– Mesosoma dull, blackish, with hardly any metallic sheen; postmarginal vein nearly as long as stigmal vein; scutellum with discernible median keel or ridge (e.g., Fig. 145) [♂ antenna, Fig. 143] .... ***Pentelicus*** Howard, see ♀ 122

129(127) Torulus with ventral margin below ventral margin of eye; tegula occasionally yellow in basal half or so 130

– Torulus with ventral margin at least level with ventral margin of eye, but usually distinctly above; tegula dark brown 131

130(129) Mesopleuron well separated from base of metasoma by propodeum, in lateral view propodeum broadly touching metacoxa (e.g., Fig. 8); occipital margin not sharp; mandible with 3 acute teeth .... ***Syrphophagus*** Ashmead, see ♀ 173

– Mesopleuron well developed and more or less touching base of metasoma, in lateral view propodeum separated from metacoxa or only just touching it (Fig. 7) or, if propodeum broadly touching metacoxa, either occipital margin sharp or mandible with 1 or 2 teeth and a broad truncation .... ***Ooencyrtus*** Ashmead, see ♀ 55

131(129) Mesosoma dorsally brown without distinct metallic blue or green sheen; occipital margin not sharp .... ***Ixodiphagus*** Howard, see ♀ 261

– Mesosoma with at least scutellum having distinct metallic green or blue sheen; occipital margin sharp .... ***Aloencyrtus*** Prinsloo, see ♀ 168

132(121) Submarginal vein with strong subapical triangular expansion (e.g., Fig. 55) 133

– Submarginal vein without strong subapical triangular expansion, occasionally parastigma swollen but not triangular 135

133(132) Body strongly dorsoventrally flattened, leaf-like; torulus near mouth margin, well below ventral margin of eye .... ***Boucekiella*** Hoffer, see ♀ 115

– Body not flattened; torulus well above mouth margin, at or above ventral margin of eye 134

134(133) Stigmal vein about as long as marginal vein; occipital margin sharp, acute; forewing entirely hyaline; posterior ocellus nearer to occipital margin than to eye .... ***Tyndarichus*** Howard, see ♀ 137

– Stigmal vein not more than about two-thirds as long as marginal vein (Fig. 55); occipital margin rounded; forewing frequently slightly infuscate behind parastigma and marginal vein .... ***Cerapterocerus*** Westwood, see ♀ 37

135(132) Mandible with a ventral peg about half way along lowermost margin (Fig. 104), broad, and never with teeth only, usually with 1 or 2 teeth and broad truncation; parasites of Diaspididae 136

– Mandible without a ventral peg and normally with 3 teeth, rarely with 1 or 2 teeth and a truncation; not recorded as parasites of Diaspididae 139

136(135) Linea calva entire 137

– Linea calva interrupted by at least 1 or 2 setae on dorsal surface 138

137(136) Mesotibia and metatibia each with a pair of well-marked, dark brown bands .... ***Ceraptroceroideus*** Girault, see ♀ 36

– Mesotibia without dark brown bands or, if so, metatibia more or less completely brown without distinct bands .... ***Neococcidencyrtus*** Compere, see ♀ 46

138(136) Head with vertex marked with orange along inner margin of eye .... ***Comperiella*** Howard, see ♀ 99

– Head without any orange on vertex .... ***Coccidencyrtus*** Ashmead, see ♀ 57

139(135) Flagellum with setae mostly relatively short, but with a few much longer setae on each funicular segment, these longest on the more basal segments .... ***Mayridia*** Mercet, see ♀ 20

– Flagellum with setae of fairly uniform length 140

140(139) Flagellum with longest setae at most twice as long as width of corresponding segment; head and mesosoma without yellow or orange areas; scutellum without apical tuft of setae 141

– Either flagellum with longest setae at least slightly more than twice as long as width of corresponding segment, or head and mesosoma with extensive yellow or orange areas, or scutellum with apical tuft of setae (e.g., Fig. 64) 152

141(140) Body strongly dorsoventrally flattened; torulus virtually on mouth margin .... ***Platencyrtus*** Ferrière, see ♀ 321

– Body not flattened; torulus separated from mouth margin by at least half its own length 142

142(141) Head in frontal view with ventral margin of torulus level with or above ventral margin of eye .... ***Ginsiana*** Erdös & Novicky, see ♀ 166

– Head in frontal view with ventral margin of torulus below ventral margin of eye 143

143(142) Mesoscutum and sometimes also head and scutellum with conspicuous, deep piliferous punctures giving appearance of surface of golf ball .... ***Bothriothorax*** Ratzeburg, see ♀ 263

– Head and mesosoma both comparatively smooth, without conspicuous piliferous punctures 144

144(143) Mesoscutum rather dull with only slight metallic brassy or greenish sheen, more or less concolorous with scutellum 145

– Mesoscutum with strong metallic green sheen, often brighter than scutellum which may be purplish and dull although occasionally brightly metallic 146

145(144) Funicle with segments short, not longer than pedicel (Fig. 107) .... ***Helygia*** Noyes & Woolley, see ♀ 140

– Funicle with segments long, all longer than pedicel .... ***Deilio*** Noyes & Woolley, see ♀ 118

146(144) Propodeum with spiracular area covered with conspicuous silvery or translucent setae 147
– Propodeum with setae on spiracular area brown, neither silvery nor conspicuous 149

147(146) Procoxa yellow or, if brown, metatibia dark brown with only a narrow yellow band apically .... ***Trichomasthus*** Thomson, see ♀ 51
– Procoxa brown; metatibia yellow basally and apically and dark brown in middle two-thirds 148

148(147) Forewing marked with 2 small, sometimes weak, infuscate areas behind parastigma and stigmal vein .... ***Habrolepopteryx*** Ashmead, see ♀ 277
– Forewing completely hyaline .... ***Ginsiana*** Erdös & Novicky, see ♀ 166

149(146) Procoxa yellow .... ***Ammonoencyrtus*** De Santis, see ♀ 104
– Procoxa dark brown or black 150

150(149) Mandible with 1 tooth and a very broad truncation .... ***Metablastothrix*** Sugonjaev, see ♀ 352
– Mandible with 3 teeth, the upper 2 sometimes very short and obtuse or truncated 151

151(150) Occipital margin more or less rounded .... ***Pseudencyrtus*** Ashmead, see ♀ 56
– Occipital margin sharp, carinate .... ***Syrphophagus*** Ashmead, see ♀ 173

152(140) Forewing with stigmal vein very short and less than half length of marginal vein; mesosoma dorsally occasionally marked with orange; scutellum sometimes with apical tuft of setae 153
– Forewing with stigmal vein longer, at least two-thirds length of marginal vein, often as long as marginal vein; mesosoma dorsally without orange areas 154

153(152) Either head or mesosoma partly orange, or scutellum with apical tuft of setae (Fig. 64), or mesoscutum dark with conspicuous silvery setae .... ***Cheiloneurus*** Westwood, see ♀ 41

– Head and mesosoma without orange areas and mesoscutum without conspicuous silvery setae; scutellum without apical tuft of setae .... ***Protyndarichoides*** Noyes, see ♀ 257

154(152) Linea calva interrupted dorsally or tegula yellow basally 155
– Linea calva not interrupted and tegula brown 157

155(154) Tegula completely brown; torulus with ventral margin slightly above ventral margin of eye; linea calva interrupted .... ***Gahaniella*** Timberlake, see ♀ 142
– Tegula yellow in basal half; torulus with ventral margin below ventral margin of eye; linea calva interrupted or entire 156

156(155) Forewing with basal cell moderately densely setose, the setae arranged in single group of at least 4 lines .... ***Blastothrix*** Mayr, see ♀ 132
– Forewing with basal cell relatively sparsely setose, the setae arranged in 2 groups of 2 lines separated by a bare area .... ***Aloencyrtus*** Prinsloo, see ♀ 168

157(154) Scutellum with longitudinally elongate, striate-reticulate sculpture over most of its length (Fig. 18), giving surface a silky appearance .... ***Lamennaisia*** Girault, see ♀ 215
– Scutellum without striate sculpture or, if so, the sculpture in basal one-third only 158

158(157) Scutellum shiny; forewing with filum spinosum converging toward basal margin of linea calva (e.g., Fig. 58) .... ***Cerchysiella*** Girault, see ♀ 148
– Scutellum with distinct sculpture, often somewhat matt; forewing with filum spinosum parallel to basal margin of linea calva or in a rounded or oval group and not converging toward basal margin of linea calva 159

159(158) Mesosoma dull, without distinct metallic green sheen 160
– Mesosoma dorsally with metallic green sheen, the sheen sometimes very strong and shiny 163

160(159) Pedicel about as long as or longer than first funicular segment; scutellum with tubercles or pits (Figs. 13, 14) (best seen in cleared, slide-mounted specimens) .... ***Forcipestricis*** Burks, see ♀ 350

– Pedicel less than two-thirds as long as first funicular segment; scutellum without tubercles or pits 161

161(160) Ocelli forming a strongly obtuse angle .... ***Deilio*** Noyes & Woolley, see ♀ 118

– Ocelli forming an acute or right angle 162

162(161) Mandible with 3 very acute and pointed teeth; minimum width of frontovertex about one-third width of head; head dark brown .. .. ***Trjapitzinellus*** Viggiani, see ♀ 211

– Mandible with upper tooth broadly rounded or truncate; minimum width of frontovertex about half width of head; head frequently partly orange .... ***Anicetus*** Howard, see ♀ 37

163(159) Scutellum strongly convex, polished apically and basal one-third with series of longitudinal ridges extending posteriorly from axillae .... ***Lirencyrtus*** Noyes, see ♀ 214

– Scutellum not strongly convex, completely sculptured but without series of basal ridges extending posteriorly 164

164(163) Pedicel at least as long as first funicular segment .... ***Ooencyrtus*** Ashmead, see ♀ 55

– Pedicel at most about two-thirds as long as first funicular segment, usually sorter 165

165(164) Head with a shallow but distinct groove connecting occipital foramen with occipital margin (Fig. 6) .... ***Achalcerinys*** Girault, see ♀ 361

– Head without groove connecting occipital foramen with occipital margin 166

166(165) All coxae dark brown; anterior ocellus separated from occipital margin by at most twice its own diameter .... ***Pseudencyrtoides*** Gordh & Trjapitzin, see ♀ 171

– At least procoxa yellow; anterior ocellus separated from occipital margin by more than twice its own diameter 167

–

167(166) Eye with posterior margin slightly concave, appearing kidney-shaped; mesopleuron more or less concolorous with dorsum of mesosoma, never partly orange; only procoxa yellow .... ***Mahencyrtus*** Masi, see ♀ 57

– Eye with posterior margin straight or slightly convex; mesopleuron frequently orange or orange-brown, at least ventrally, distinctly paler than dorsum of mesosoma; all coxae more or less yellow, although mesocoxa and metacoxa a little dusky .... ***Comones*** Noyes & Woolley, see ♀ 54

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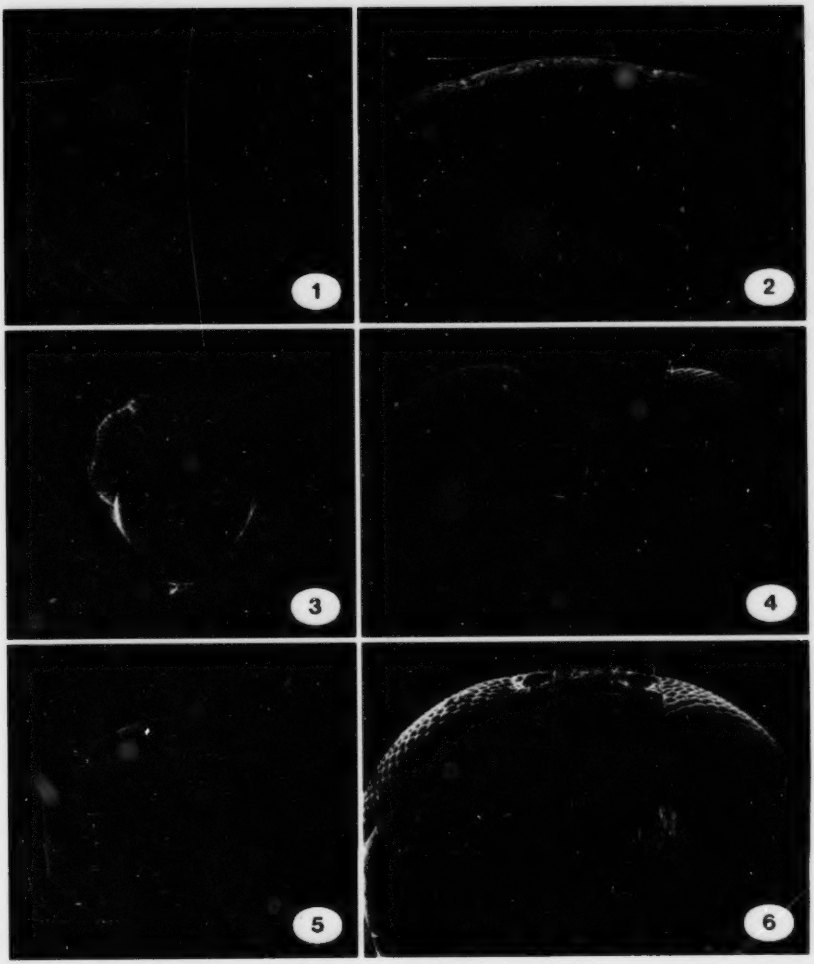
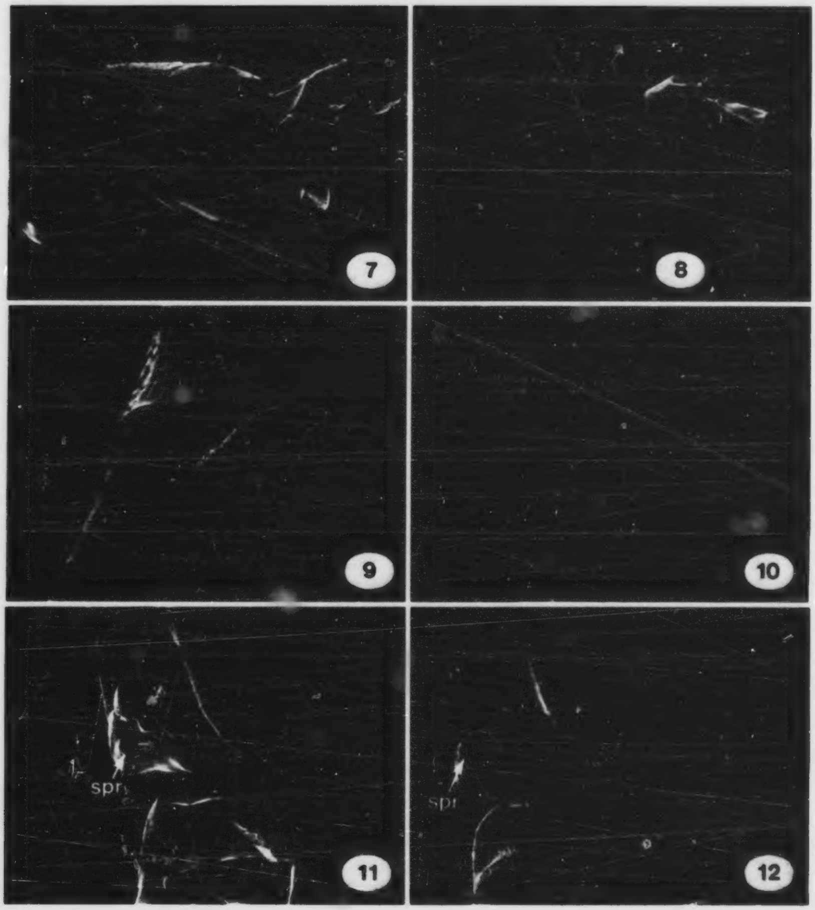
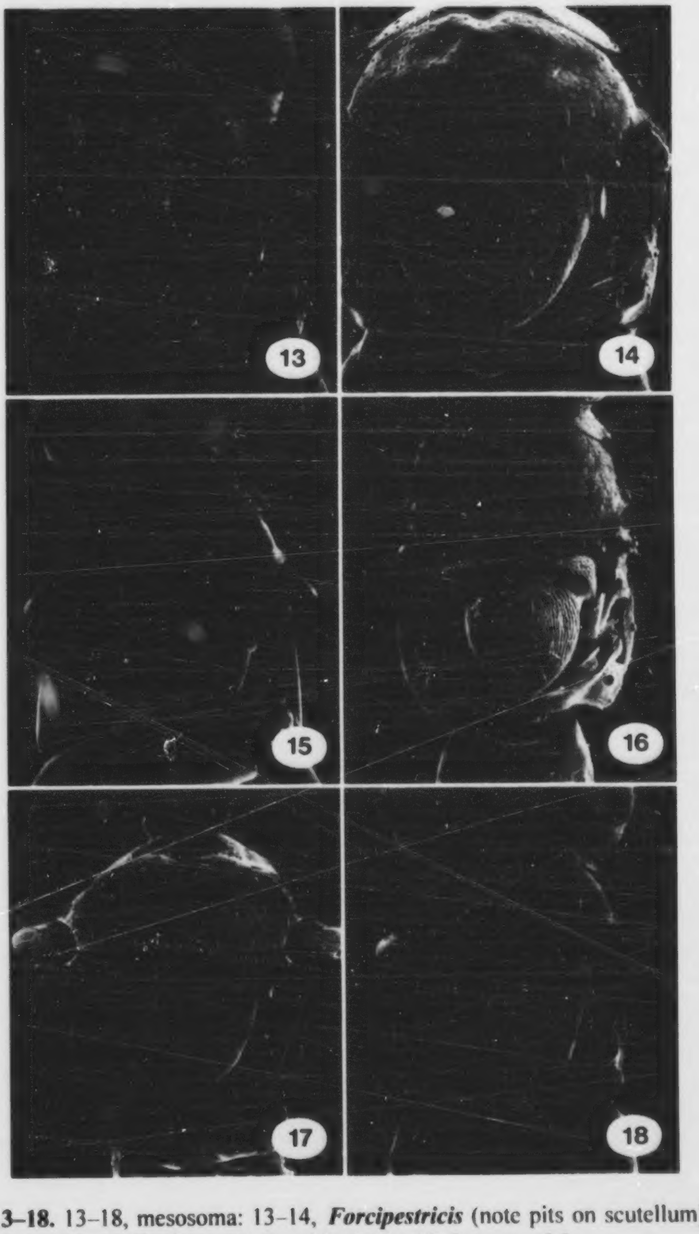


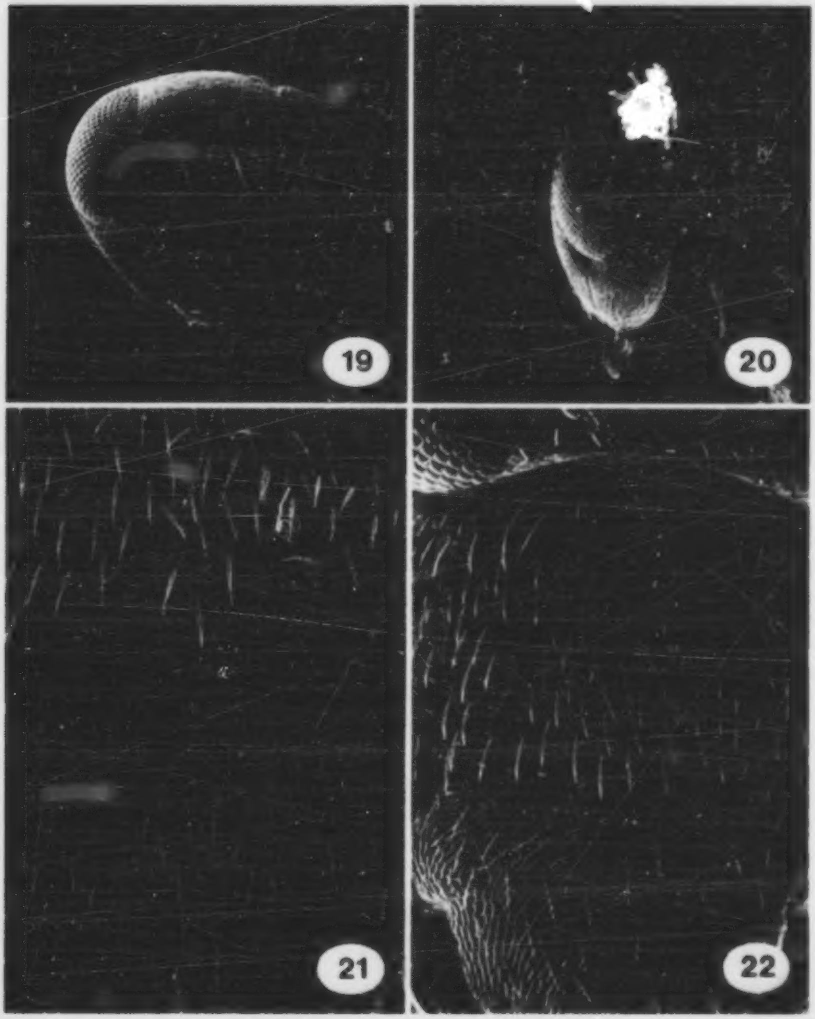
Figs. 1–6. 1–6, head: 1, ***Gyranusoidea***; 2, ***Apoanagyrus***; 3, ***Pseudleptomastix***; 4, ***Anagyrus fusciventris*** (Girault); 5, ***Doliphocerus***; 6, ***Achalcerinys***.



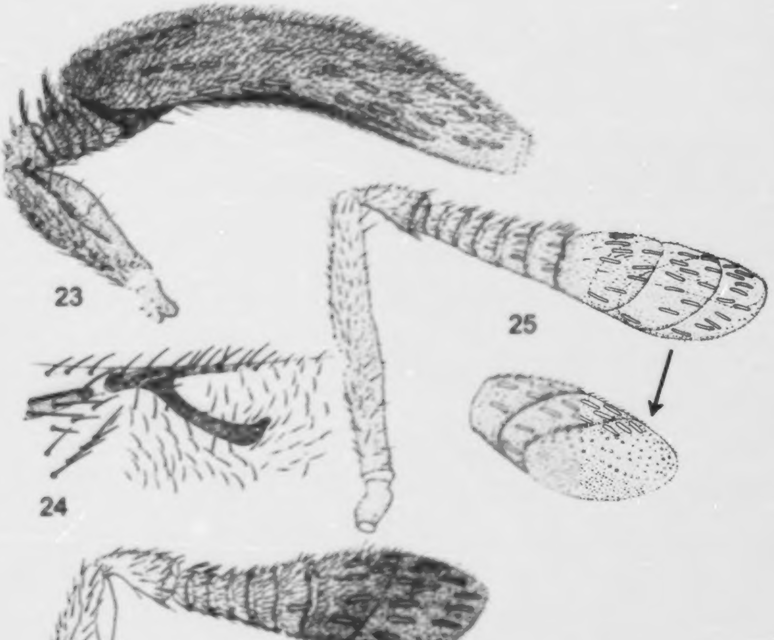
Figs. 7–12. 7–8, body: 7, ***Ooencyrtus***; 8, ***Psyllaephagus***. 9, ***Meromyzobia***, mesotibial spur. 10, ***Prionomitus***, mesosoma (note pits on mesoscutum). 11–12, middle of body (dorsal): 11, ***Copidosomopsis***; 12, ***Copidosoma***.



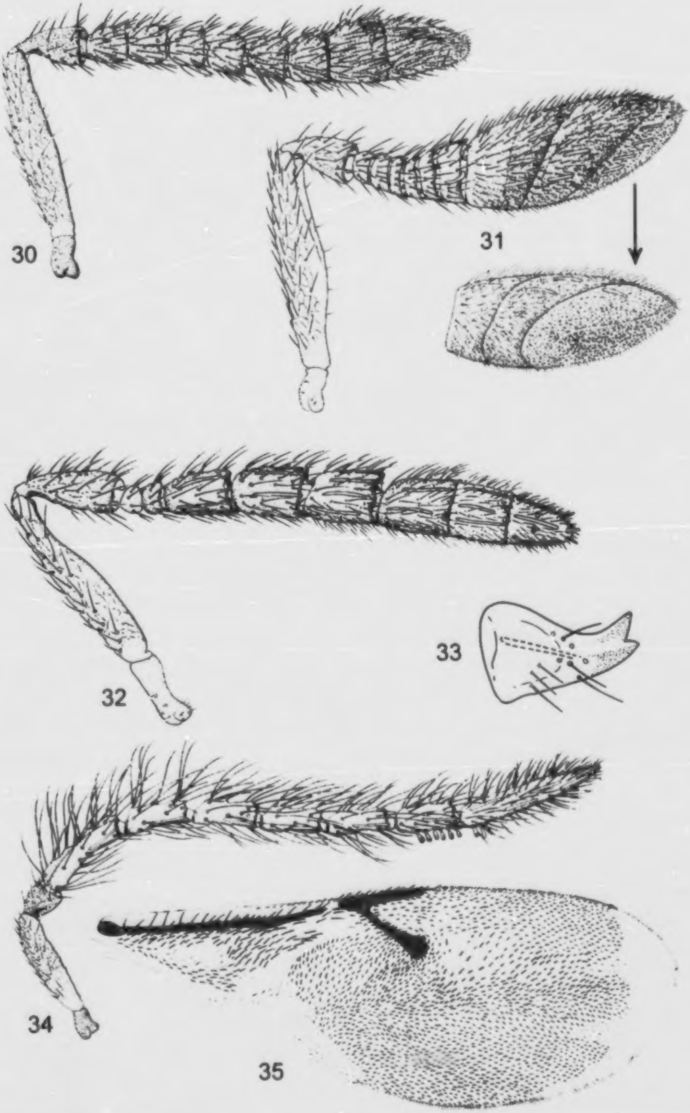
Figs. 13–18. 13–18, mesosoma: 13–14, ***Forcipestricis*** (note pits on scutellum); 15, ***Ooencyrtus***; 16, ***Apsilophrys***; 17, ***Parablatticida***; 18, ***Lamennaisia***.



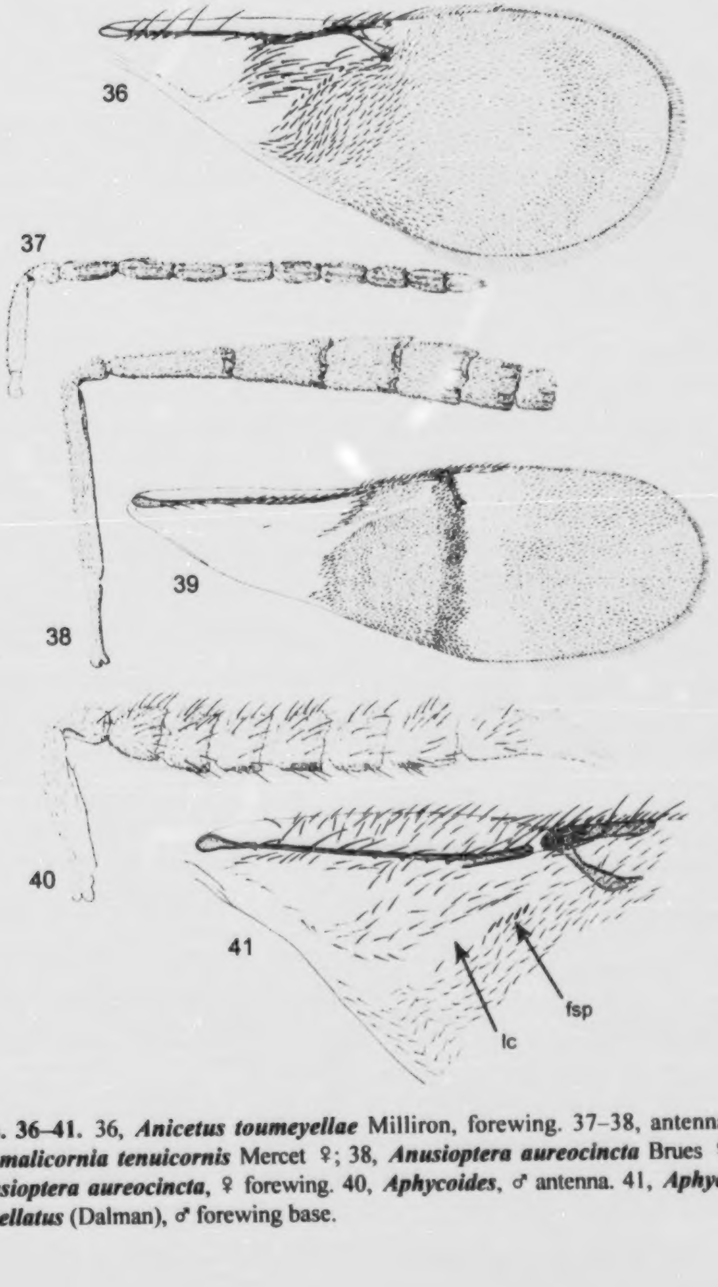
Figs. 19–22. 19–20, head: 19, ***Mucrencyrtus***; 20, ***Paratetracnemoidea***. 21, ***Anagyrus fusciventris*** (Girault), posterior mesoscutum–anterior scutellum. 22, ***Apoanagyrus***, posterior head–scutellum.



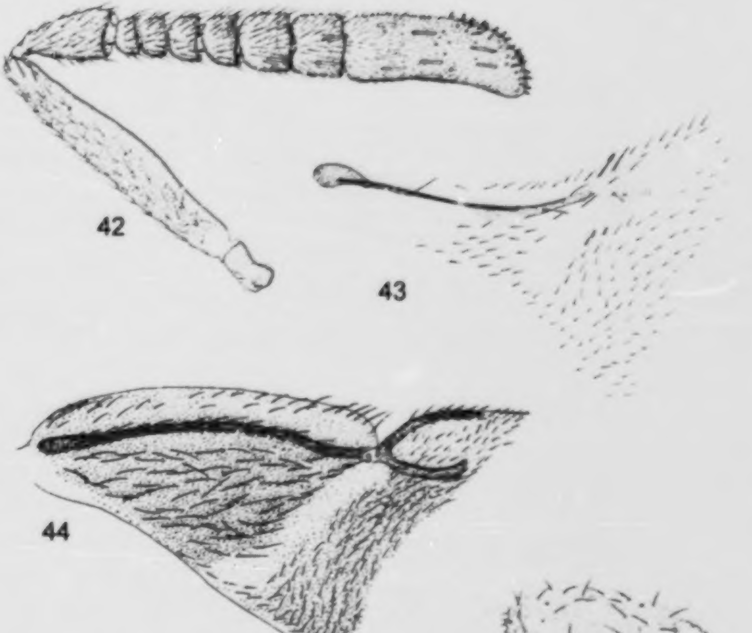
Figs. 23–29. 23, ***Aenasius maplei*** Compere, ♂ antenna. 24, ***A. advenus*** Compere, forewing venation. 25, ***A. pergandei*** (Howard), ♀ antenna (including reverse side of clava). 26, ***Aeptencyrtus bruchi*** (De Santis), ♀ antenna. 27–29, ***Aesaria perseus*** Noyes & Woolley ♀: 27, forewing base; 28, antenna; 29, brachypterous forewing.



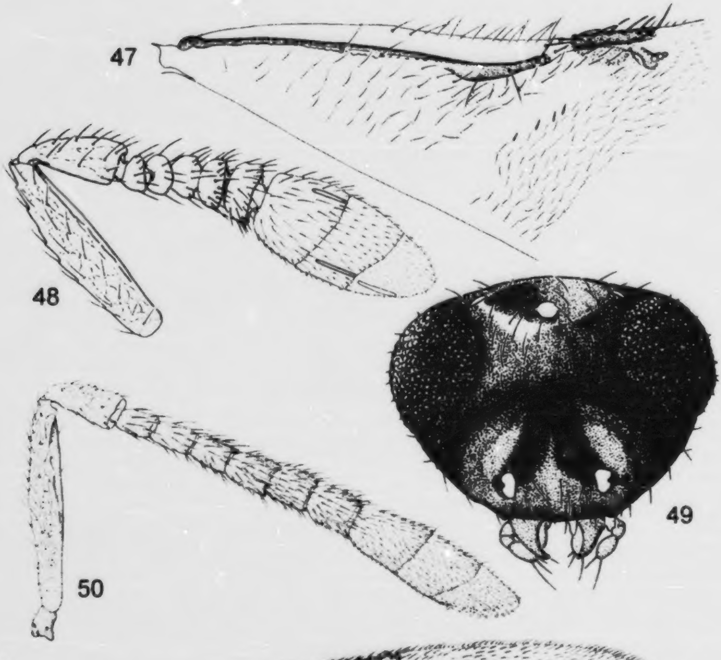
Figs. 30–35. 30, ***Agarwalencyrtus***, ♂ antenna. 31, ***Agarwalencyrtus citri*** (Agarwal), ♀ antenna (including reverse side of clava). 32, ***Ameromyzobia aphelinoides*** Girault, ♀ antenna. 33, ***Anagyrus fusciventris*** (Girault), mandible. 34, ***A. pseudococci*** (Girault), ♂ antenna. 35, ***Anagyrus***, forewing.



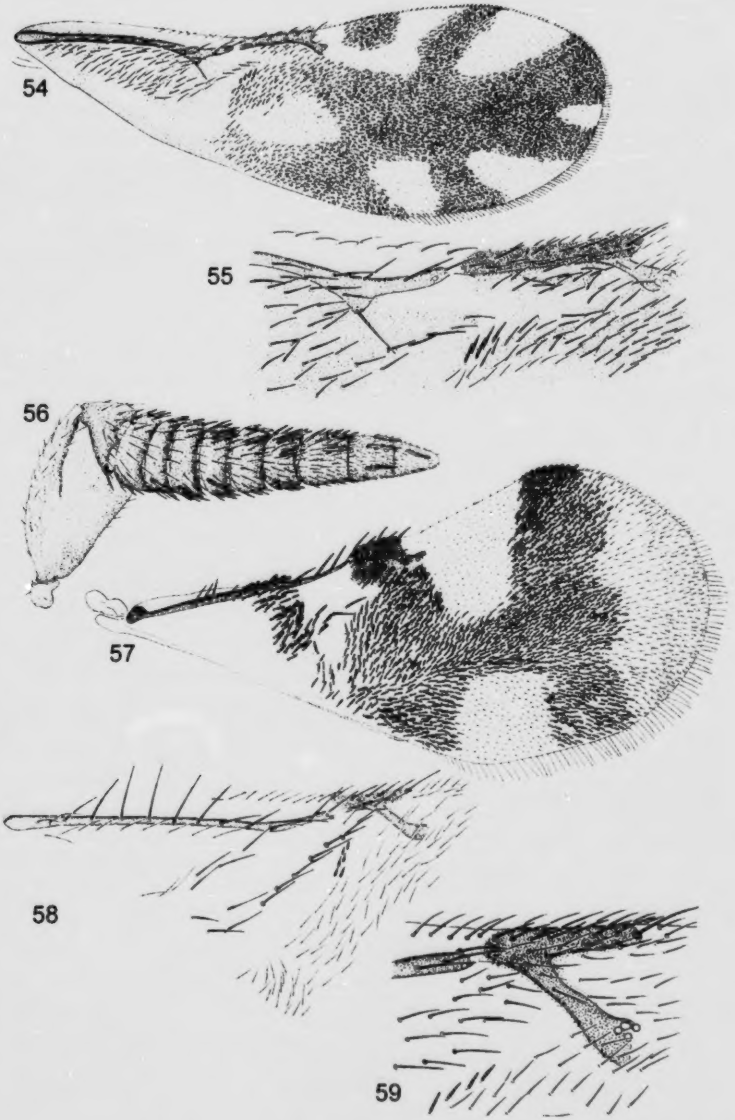
Figs. 36–41. 36, ***Anicetus toumeyellae*** Milliron, forewing. 37–38, antenna: 37, ***Anomalicornia tenuicornis*** Mercet ♀; 38, ***Anusioptera aureocincta*** Brues ♀. 39, ***Anusioptera aureocincta***, ♀ forewing. 40, ***Aphycoides***, ♂ antenna. 41, ***Aphycoides clavellatus*** (Dalman), ♂ forewing base.



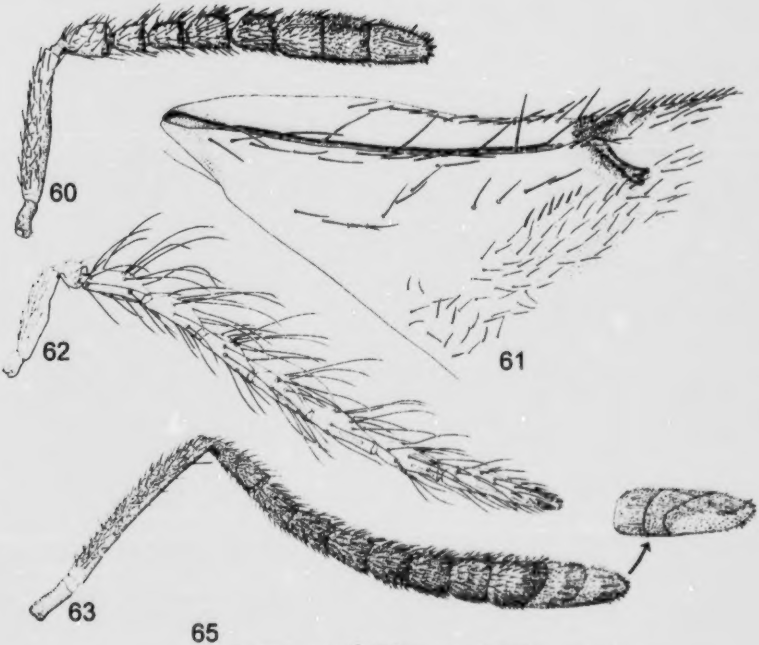
Figs. 42–46. 42, ***Aphycus***, ♂ antenna. 43–44, forewing base: 43, ***Arrhenophagus chionaspidis*** Aurivillius; 44, ***Avernes gela*** Noyes & Woolley ♀. 45, ***Avetianella***, ♀ head. 46, ***Blastothrix longipennis*** Howard, ♂ antenna.



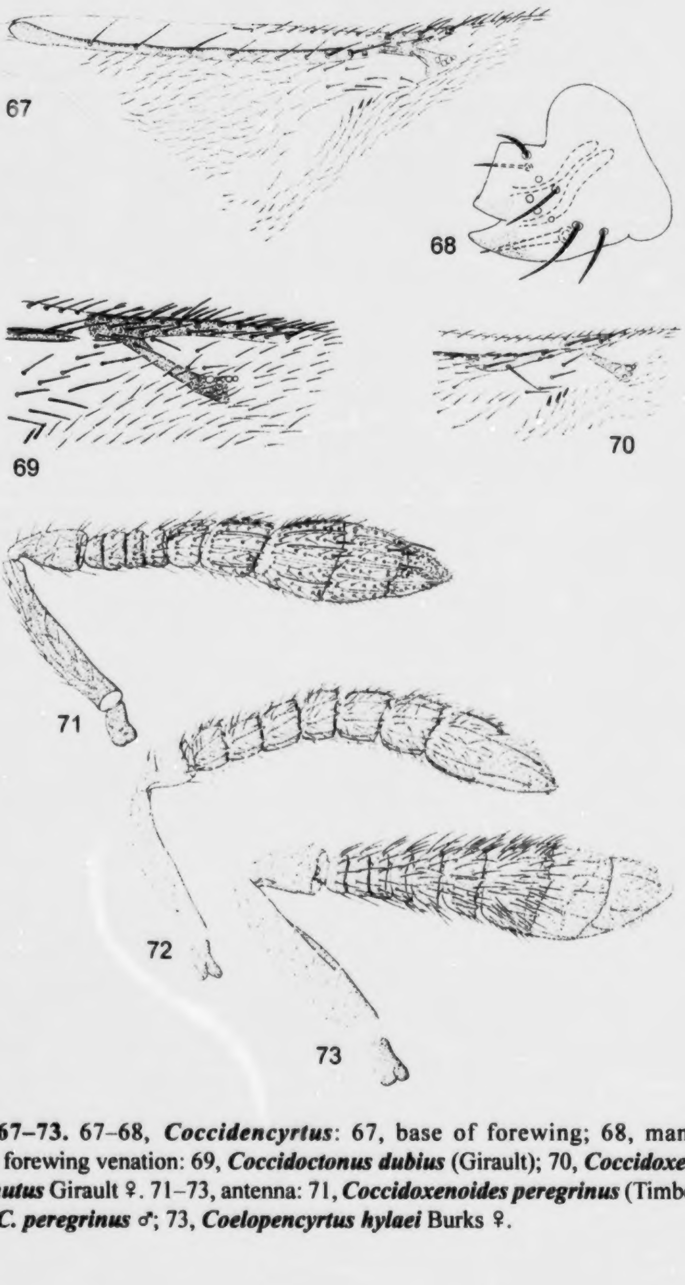
Figs. 47–53. 47, ***Boucekiella depressa*** Hoffer, forewing base. 48, ***Bothriocraera flavipes*** Timberlake, ♀ antenna. 49, ***Brachyplatycerus***, head. 50–51, ***Casus parma*** Noyes & Woolley ♀: 50, antenna; 51, forewing. 52, ***Caenocercus puncticollis*** Thomson, forewing venation. 53, ***Carabunia myersi*** Waterston, mandible.



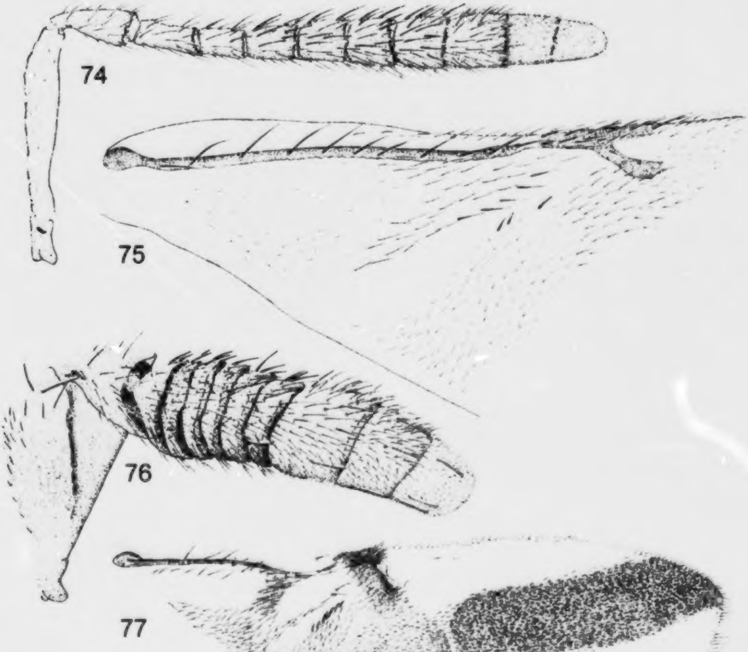
Figs. 54–59. 54–55, ***Cerapterocerus mirabilis*** Westwood ♀: 54, forewing; 55, forewing venation. 56–57, ***Ceraptroceroideus*** ♀: 56, antenna; 57, forewing. 58, ***Cerchysiella laevigata*** (De Santis), forewing base. 59, ***Cerchysius***, forewing venation.



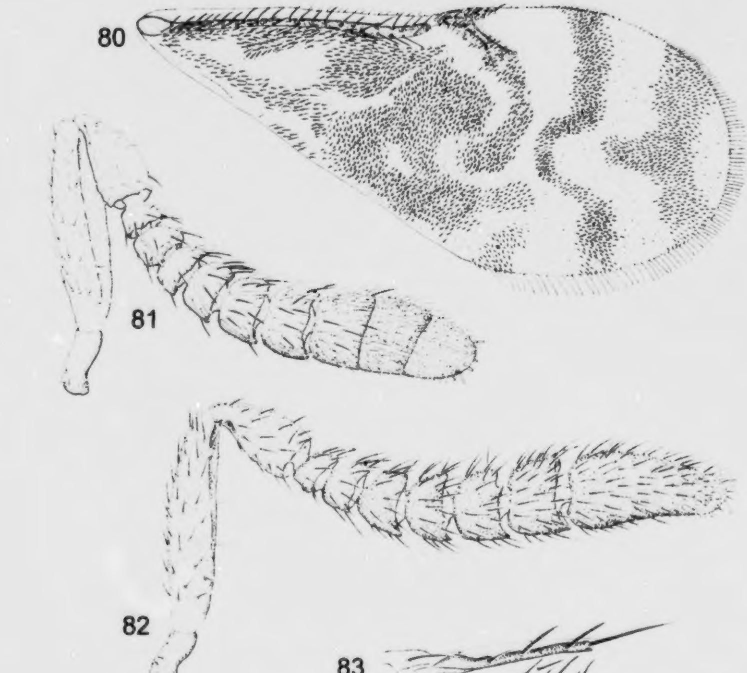
Figs 60–66. 60–61, ***Cercobelus*** ♀: 60, antenna; 61, forewing. 62, ***Cheiloneurus inimicus*** Compere, ♂ antenna. 63, ***Cheiloneurus***, ♀ antenna (including reverse side of clava). 64, ***C. swezeyi*** Ashmead, ♀ scutellum and axillae. 65–66, ♀ forewing base: 65, ***Cheiloneurus***; 66, ***Chrysoplatycerus ferrisi*** Timberlake.



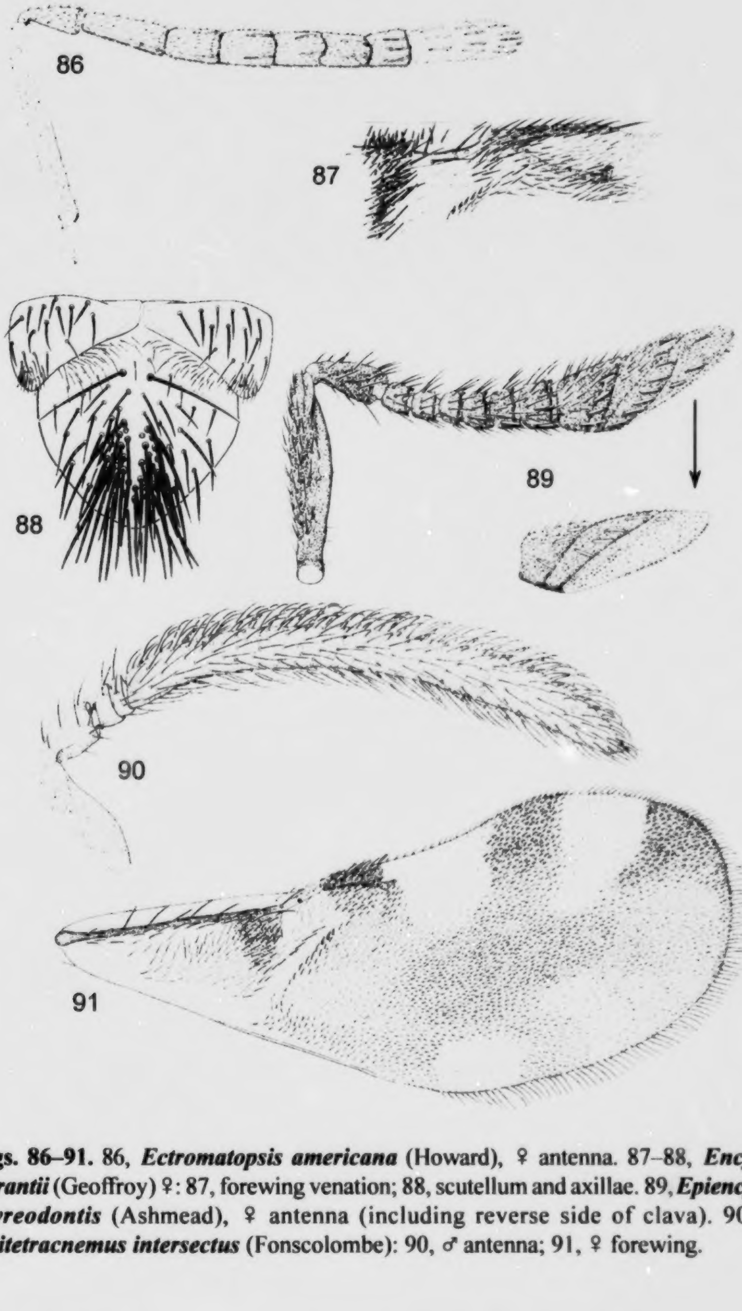
Figs. 67–73. 67–68, ***Coccidencyrtus***: 67, base of forewing; 68, mandible. 69–70, forewing venation: 69, ***Coccidoctonus dubius*** (Girault); 70, ***Coccidoxenoides perminutus*** Girault ♀. 71–73, antenna: 71, ***Coccidoxenoides peregrinus*** (Timberlake) ♀; 72, ***C. peregrinus*** ♂; 73, ***Coelopencyrtus hylaei*** Burks ♀.



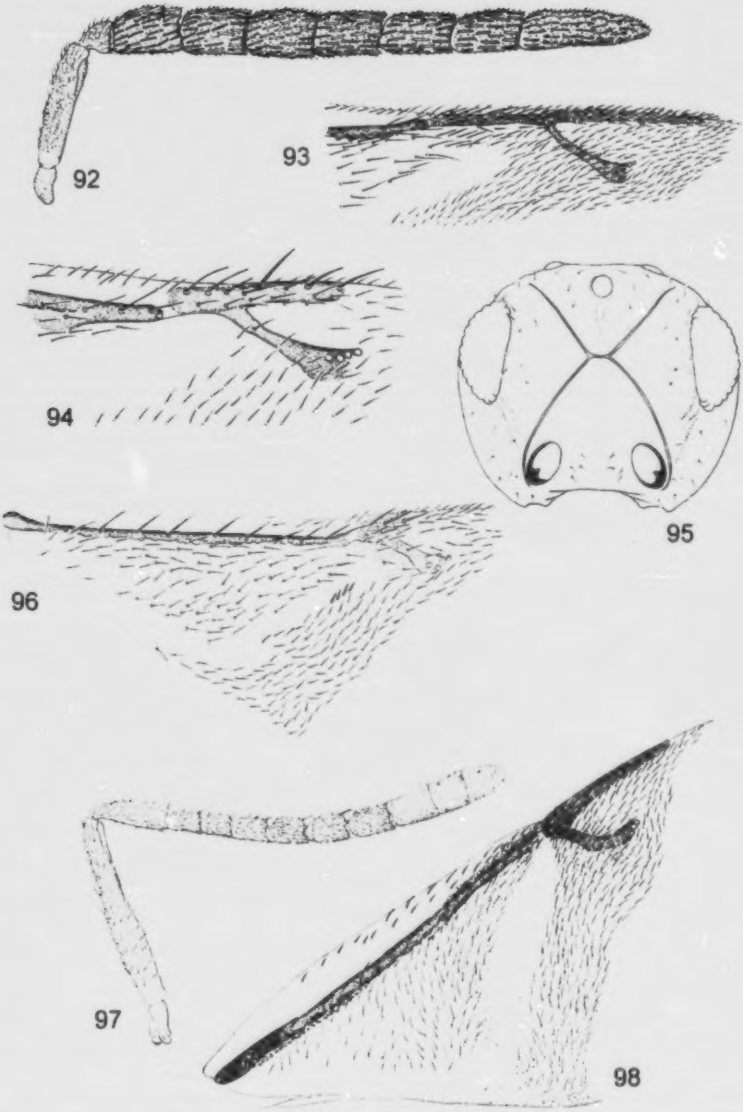
Figs. 74–79. 74–75, ***Comones ferrieri*** (Burks) ♀: 74, antenna; 75, forewing base. 76–77, ***Comperiella bifasciata*** Howard ♀: 76, antenna; 77, forewing. 78, ***Copidosoma floridanum*** (Ashmead), ♀ antenna. 79, ***C. bakeri*** (Howard), ♀ forewing.



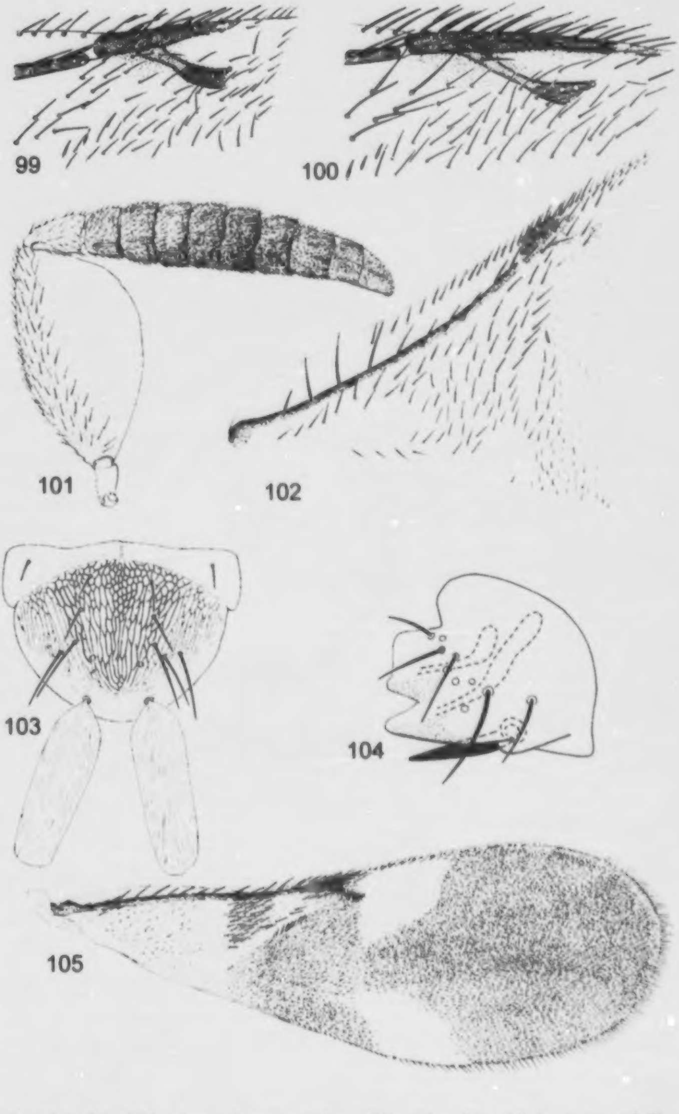
Figs. 80–85. 80, ***Dicarnosis ripariensis*** Kerrich, ♀ forewing. 81–82, ***Ebito dereus*** Noyes & Woolley, antenna: 81, ♀; 82, ♂. 83–85, ***Ectroma***: 83, ♀ forewing; 84, ♀ antenna; 85, ♂ antenna.



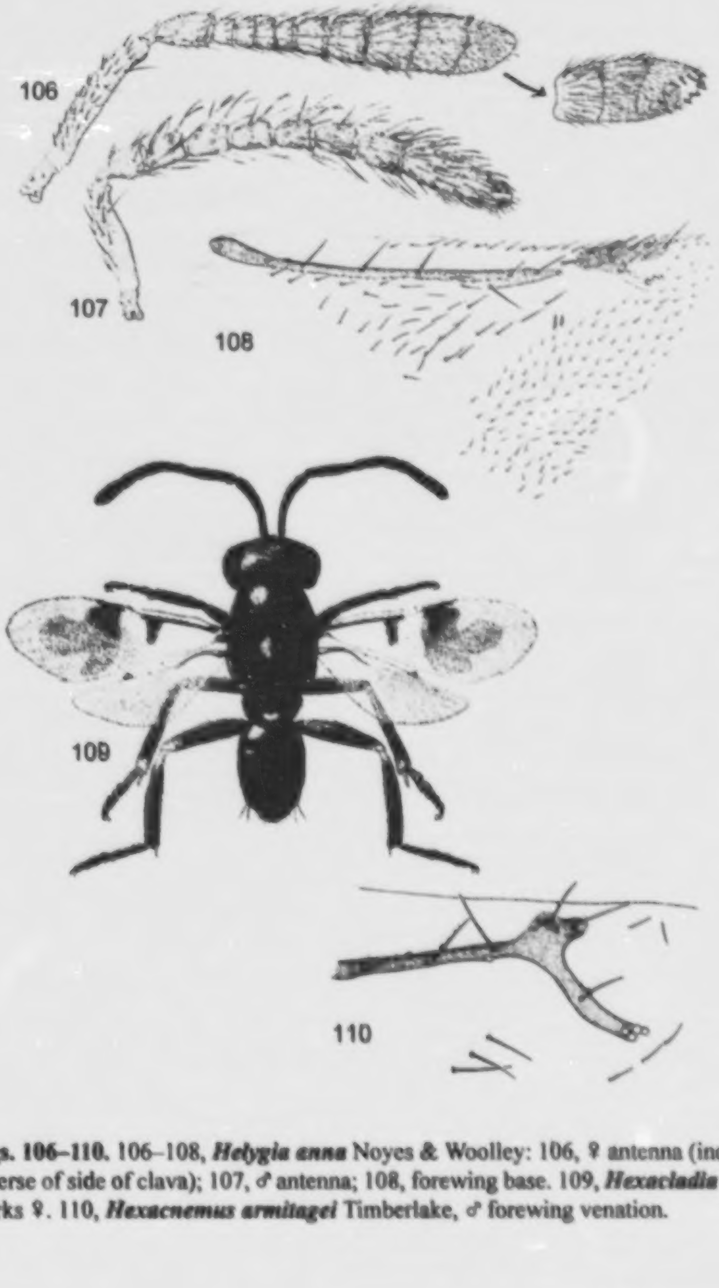
Figs. 86–91. 86, ***Ectromatopsis americana*** (Howard), ♀ antenna. 87–88, ***Encyrtus aurantii*** (Geoffroy) ♀: 87, forewing venation; 88, scutellum and axillae. 89, ***Epiencyrtus thyreodontis*** (Ashmead), ♀ antenna (including reverse side of clava). 90–91, ***Epitetracnemus intersectus*** (Fonscolombe): 90, ♂ antenna; 91, ♀ forewing.



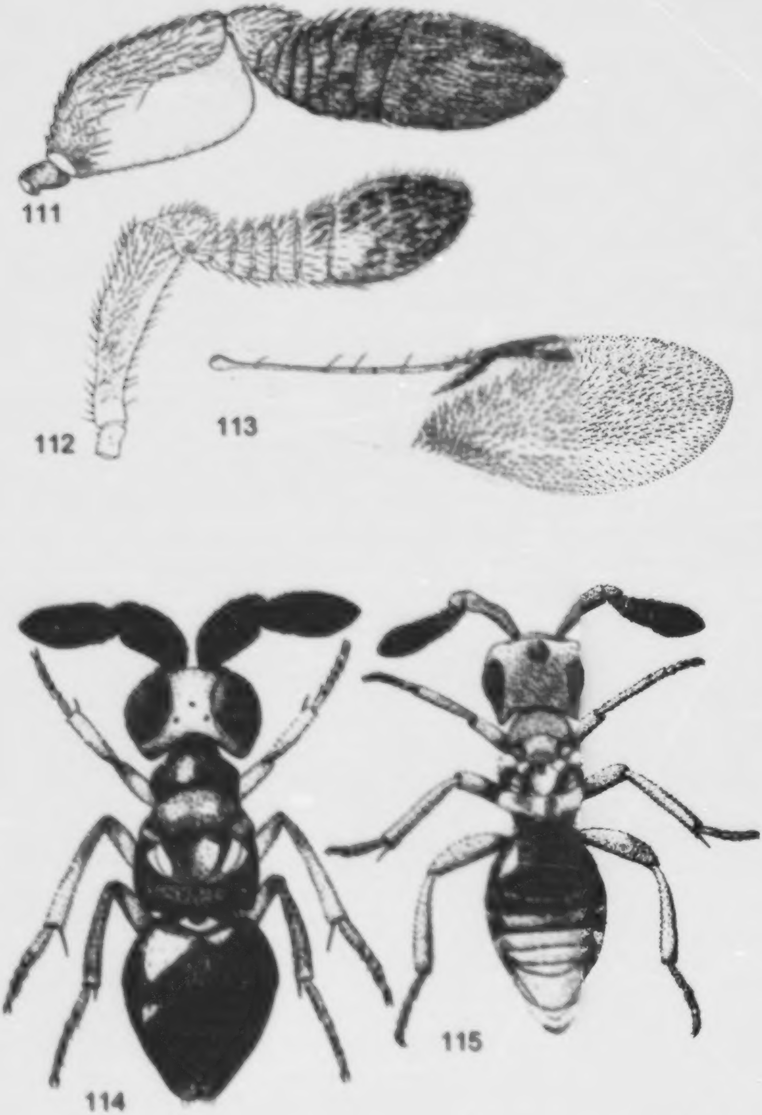
Figs. 92–98. 92–93, ***Ericydnus***: 92, ♂ antenna; 93, forewing venation. 94–95, ***Eucoccidophagus***: 94, forewing base; 95, ♀ head. 96–97, ***Euogus ravenna*** Noyes & Woolley ♀: 96, forewing base; 97, antenna. 98, ***Extencyrtus edessa*** Noyes & Woolley, ♀ forewing base.



Figs 99–105. 99–100, forewing venation: 99, ***Forcipestricis gazeaui*** Burks; 100, ***Exoristobia pleuralis*** (Ashmead). 101, ***Formicencyrtus thoreauini*** Girault, ♀ antenna. 102, ***Gahaniella saissetiae*** Timberlake, forewing base. 103–104, ***Habrolepis dalmanni*** (Westwood): 103, ♀ scutellum and axillae; 104, mandible. 105, ***Habrolepopteryx pulchripennis*** (Ashmead), ♀ forewing.



Figs. 106–110. 106–108, ***Helygia anna*** Noyes & Woolley: 106, ♀ antenna (including reverse of side of clava); 107, ♂ antenna; 108, forewing base. 109, ***Hexacladia hilaris*** Burks ♀. 110, ***Hexacnemus armitagei*** Timberlake, ♂ forewing venation.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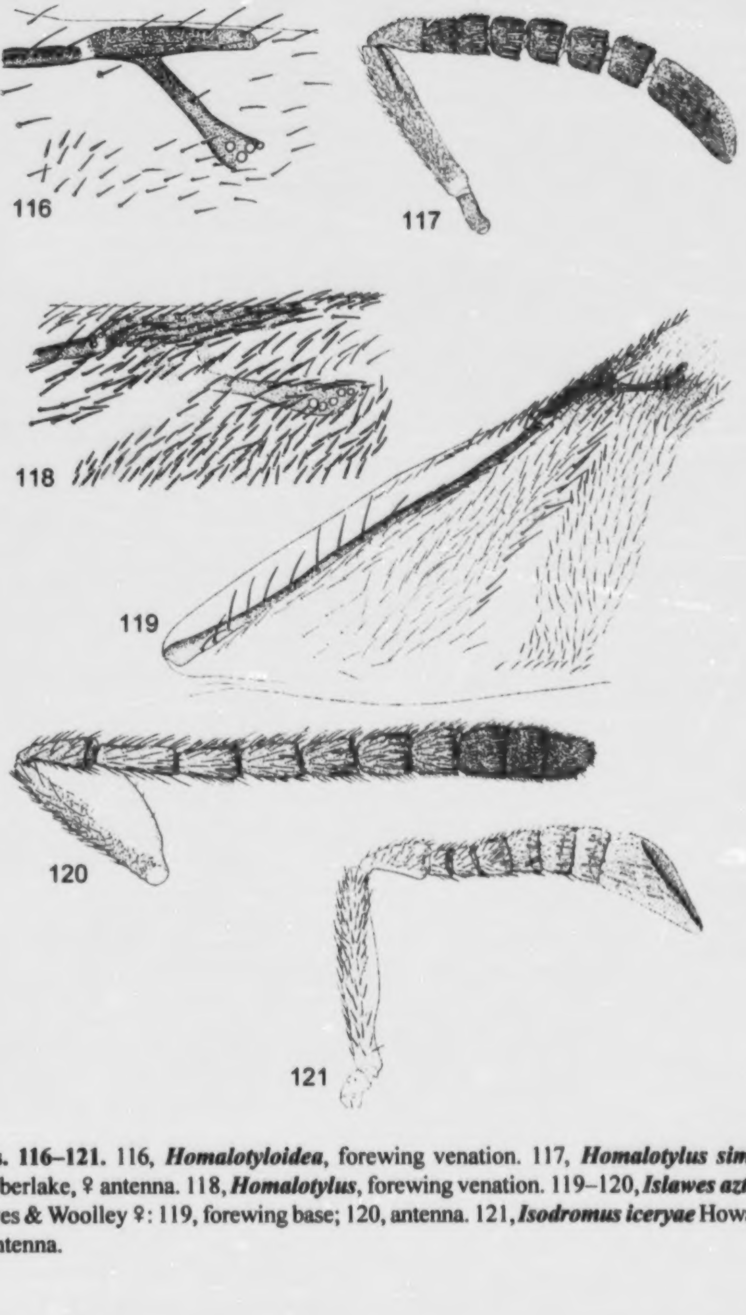

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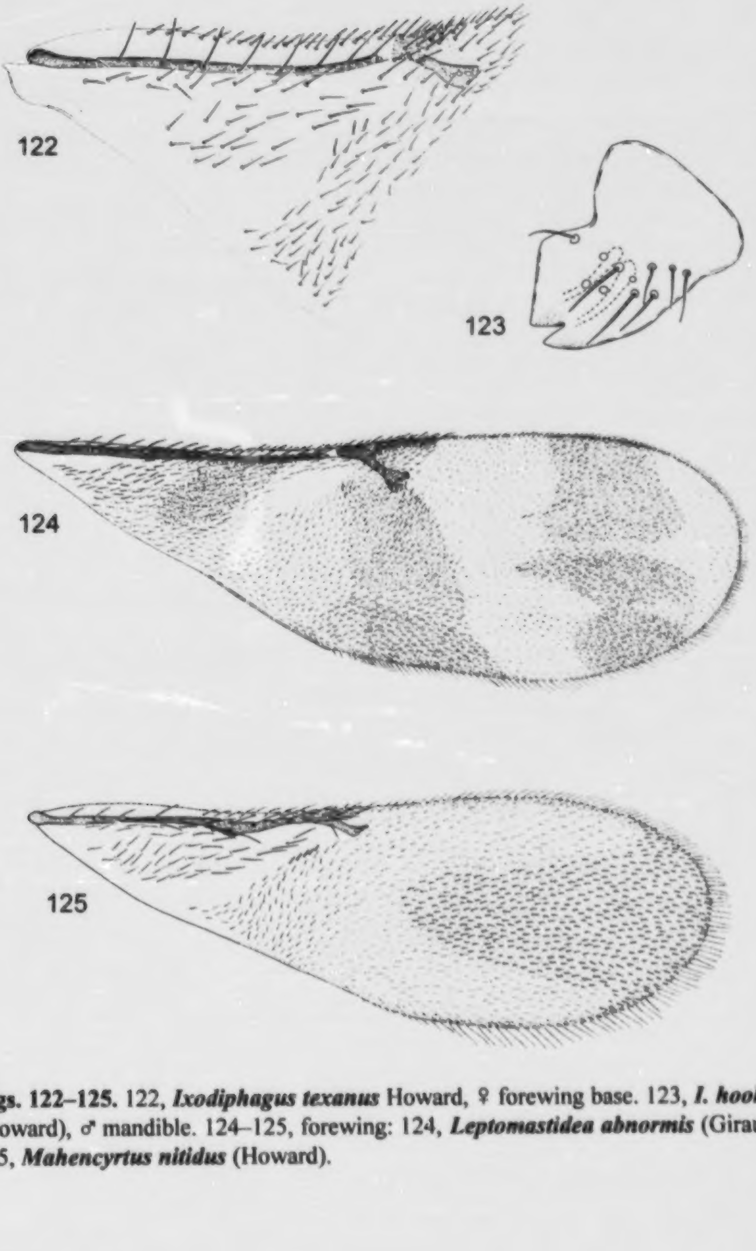
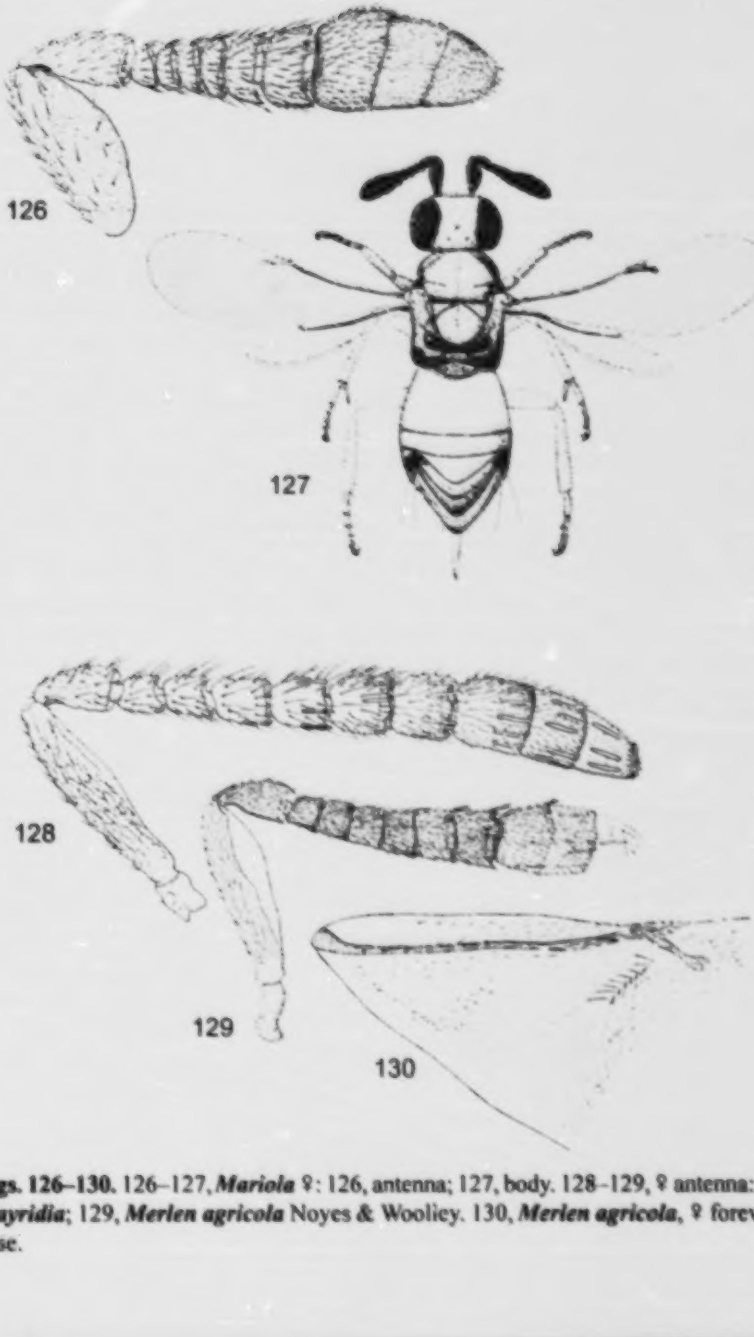


Figs. 122–125. 122, ***Ixodiphagus texanus*** Howard, ♀ forewing base. 123, ***I. hookeri*** (Howard), ♂ mandible. 124–125, forewing: 124, ***Leptomastidea abnormis*** (Girault); 125, ***Mahencyrtus nitidus*** (Howard).



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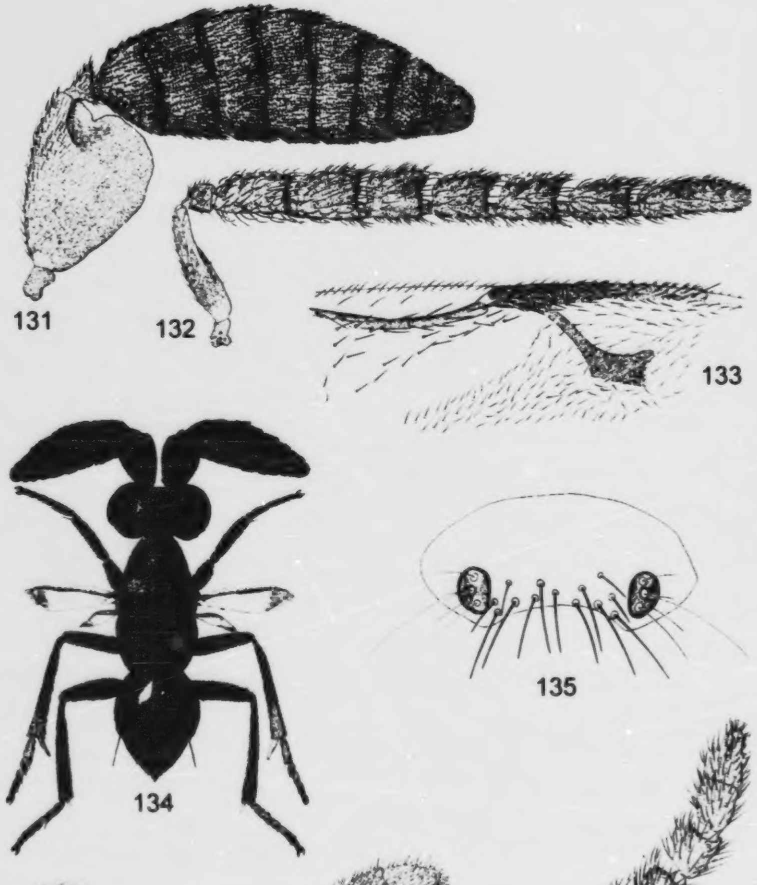
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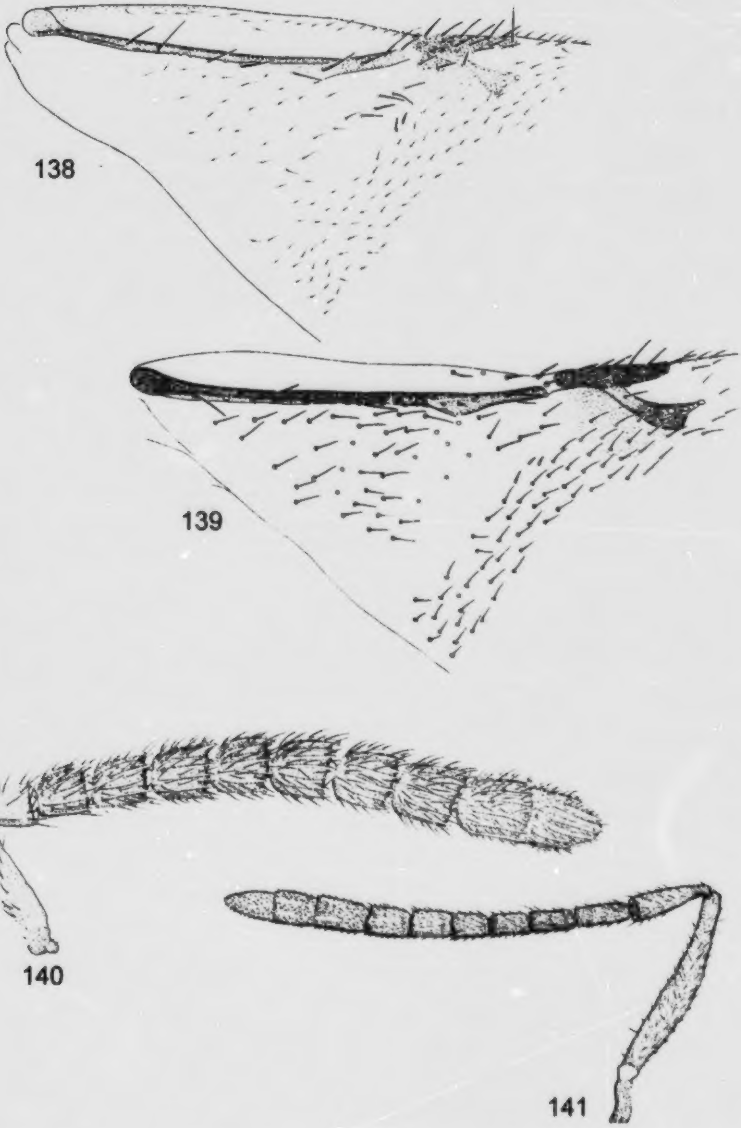

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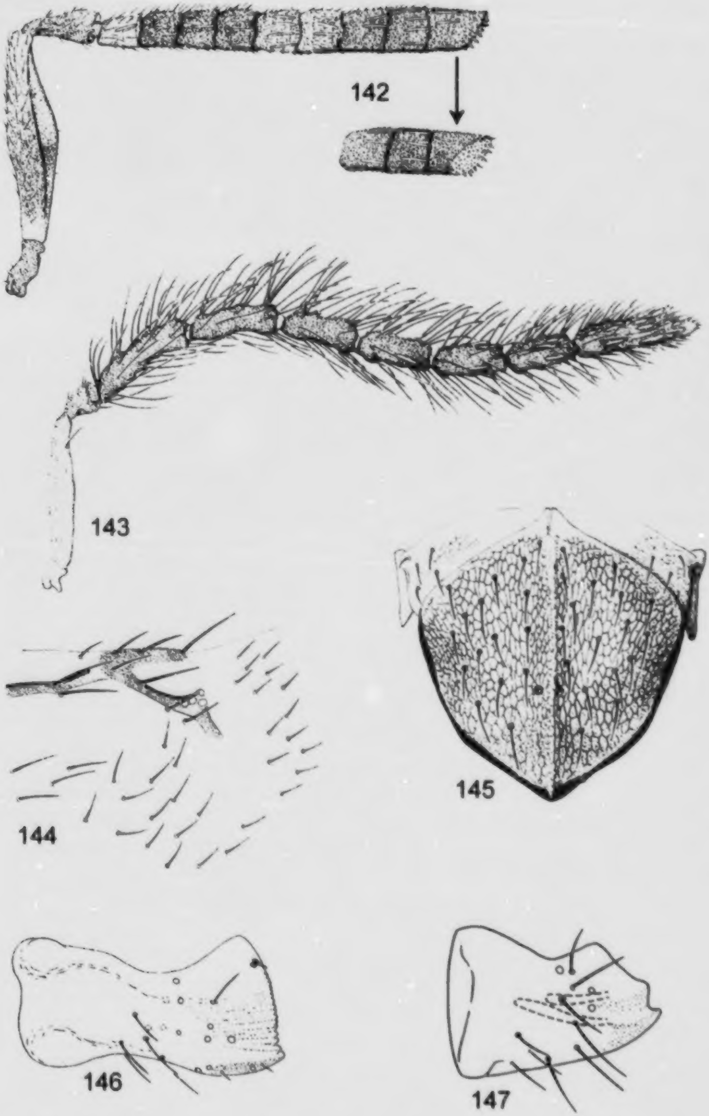

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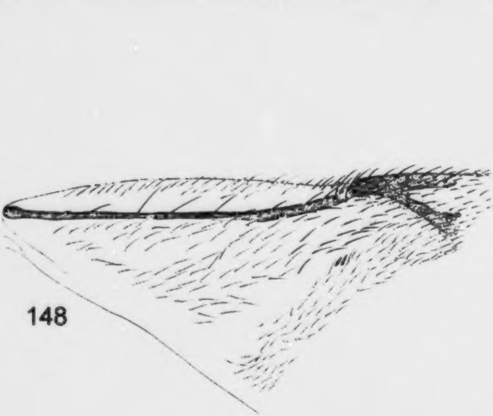

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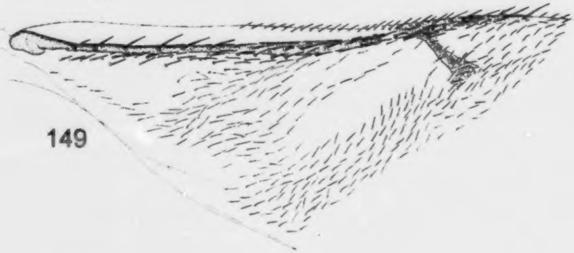

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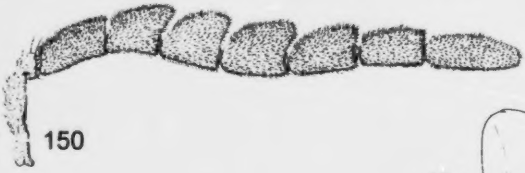

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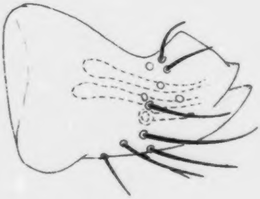

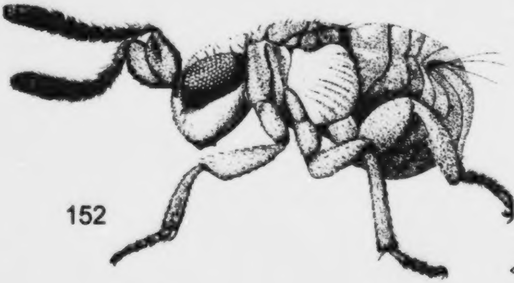

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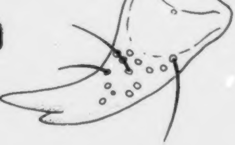
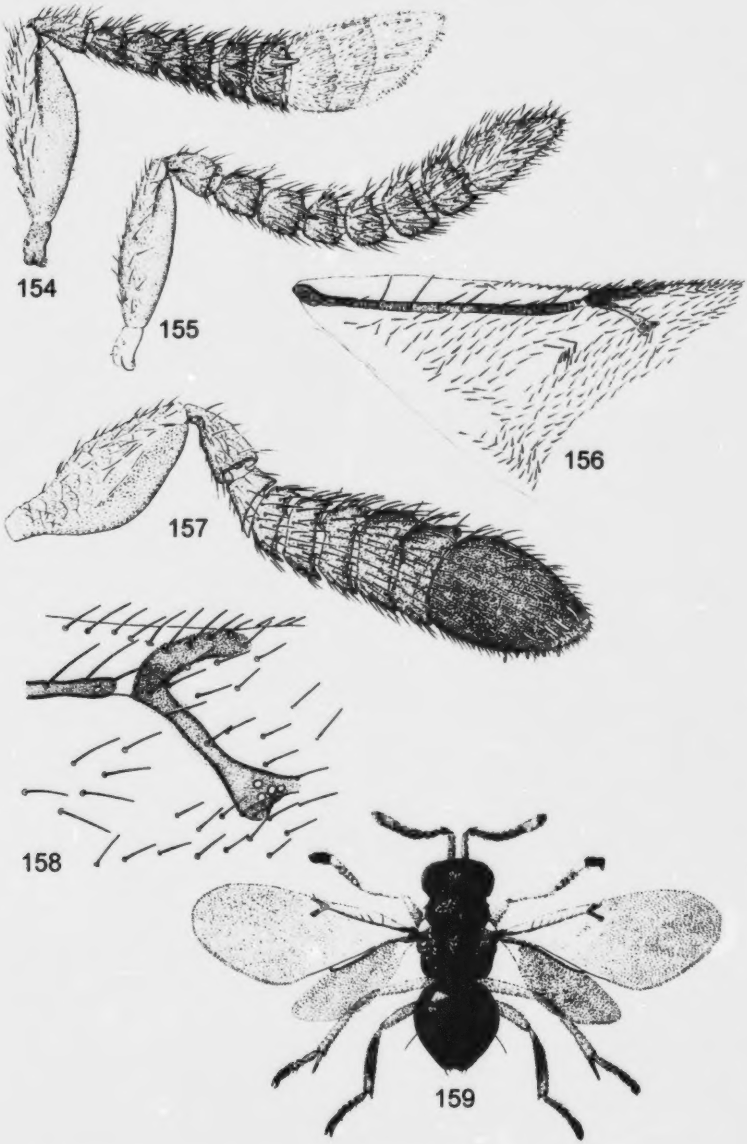


Figs. 148–153. 148–149, forewing base: 148, ***Pseudencyrtus cecidomyiae*** (Howard); 149, ***Pseudleptomastix squammulata*** Girault. 150, ***Psyllaephagus***, ♂ antenna. 151, ***Psyllaephagus trioziphagus*** (Howard), ♂ mandible. 152, ***Pulexencyrtus medusa*** Noyes & Woolley ♀. 153, ***Rhytidothorax***, mandible.



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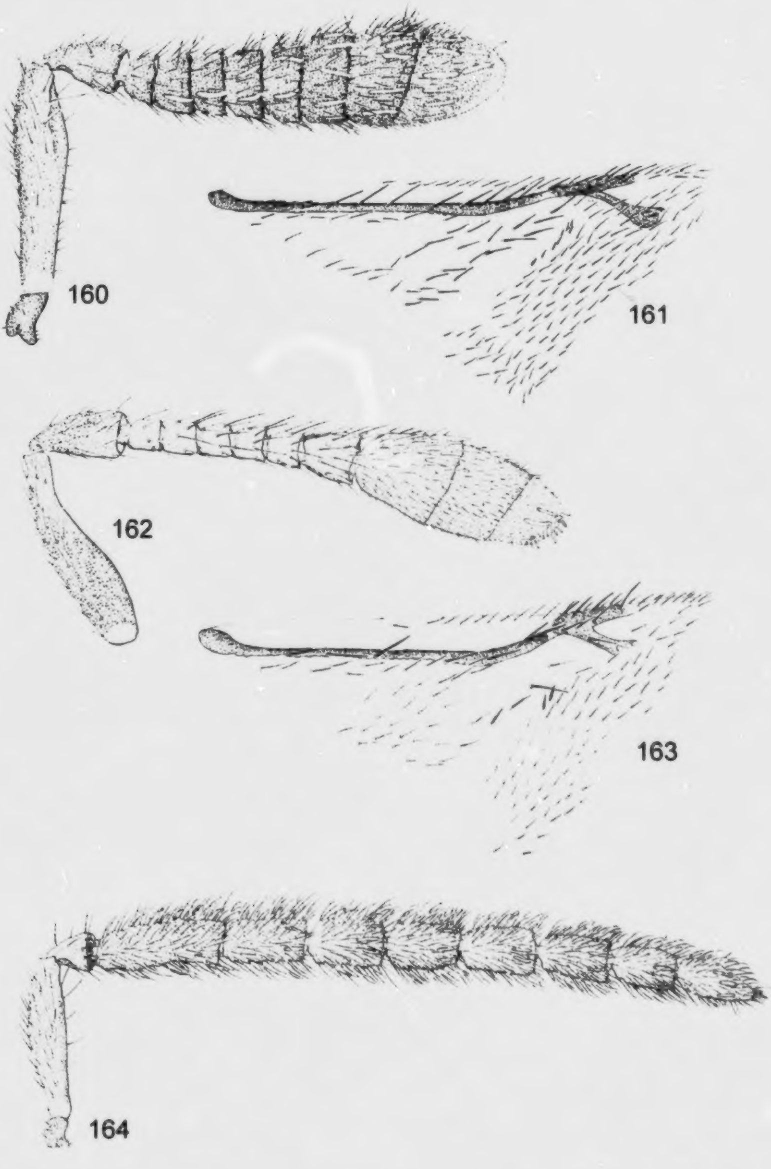

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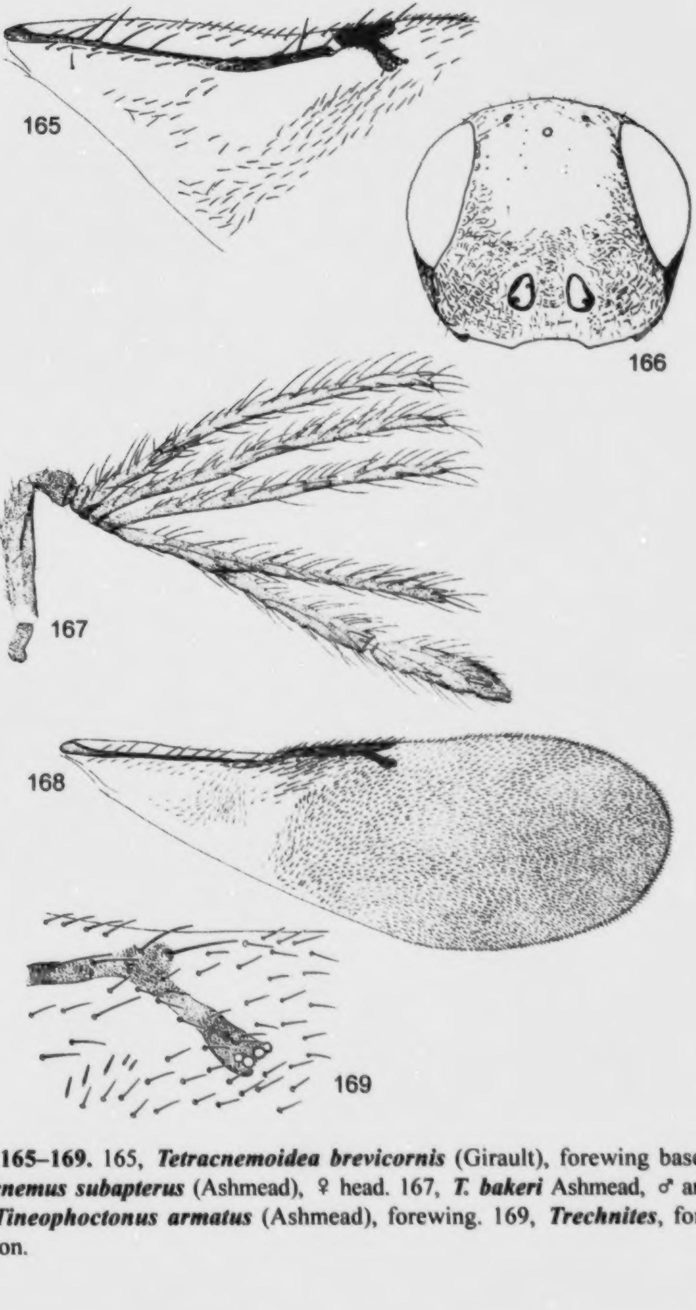

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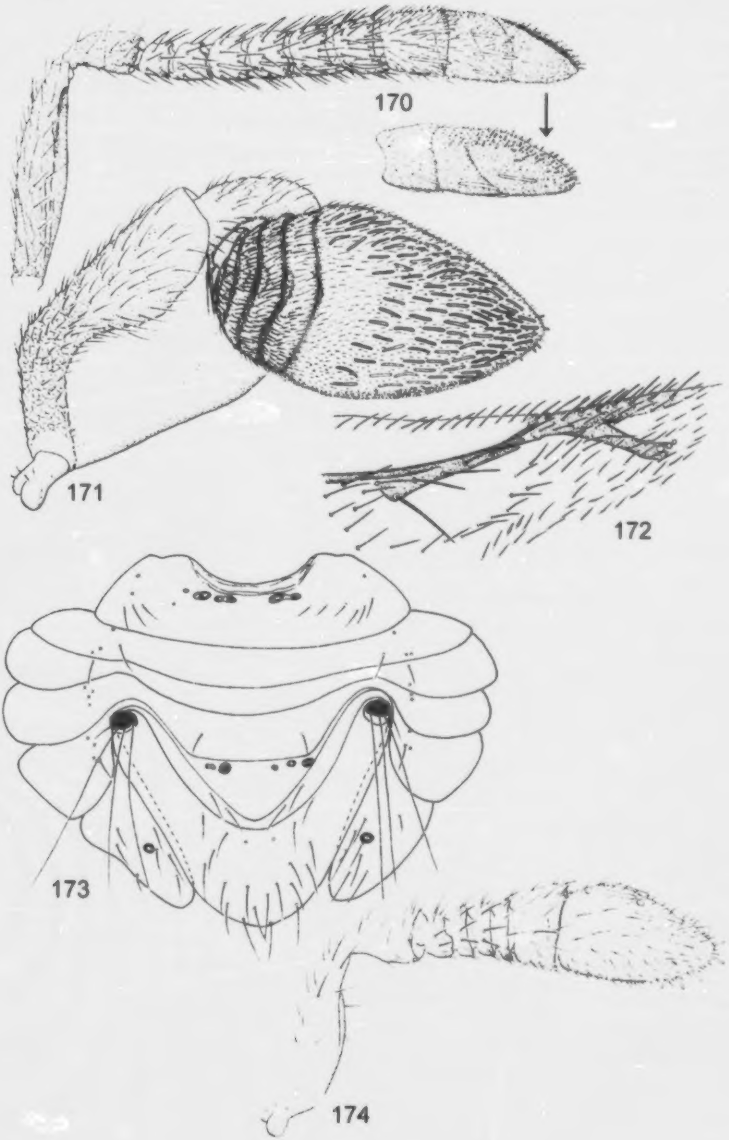

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Chapter 9. **EUCHARITIDAE**

John Heraty

Recognition. New World Eucharitidae are recognized by the following features: mandibles elongate and sickle-shaped (Fig. 9); malar sulcus absent; labrum with single row of 4–16 marginal digits; pronotum reduced and ventral to mesoscutum, not visible in dorsal view (Figs. 10, 11); petiole elongate, usually longer than metacoxa; female with gaster large; both sexes with first gastral tergum usually more than half as long as gaster (Figs. 2, 5, 6).

Systematics. In the New World, Eucharitidae are comprised of two subfamilies, Oraseminae and Eucharitinae, which together form a monophyletic group. Monophyly of these two subfamilies is supported by the above features as well as by features of the strongly sclerotized first-instar larva (Heraty and Darling 1984).

In addition to Oraseminae and Eucharitinae, Bouček (1988) recognized three other subfamilies found in the Old World tropics. These three subfamilies are not treated here and the following comments refer strictly to Oraseminae and Eucharitinae in the New World (i.e., Eucharitidae sensu Heraty 1985). Eucharitidae are most closely related to the families Perilampidae (based largely on features of the first-instar larva) and Pteromalidae. Both Eucharitidae and Perilampidae have sometimes been placed together as subfamilies in Pteromalidae.

Biology. New World species of Eucharitidae are parasites of ant pupae (Formicidae). Eggs are deposited away from the host into plant tissue and the active first-instar larva, termed a planidium, gains access to the ant colony. The planidium, which is less than 0.9 mm in length, moves by looping or jumping, and enters the nest by phoretic attachment to a foraging ant or possibly through use of an intermediate host such as an immature individual of Thysanoptera. Initially, the eucharitid larva parasitizes the larva of the host ant, but development is completed on the host pupa. Pupation and emergence of the parasite takes place in the ant nest.

Behavior of the larva on the host pupa is virtually the same for all Eucharitidae, but major differences are found in ovipositional behavior and host choice. Oraseminae deposit single eggs into incisions in leaf tissue that are formed by the enlarged ovipositor; their hosts are generally confined to the Myrmicinae, but one North American species has been associated with Formicinae (Johnson et al. 1986). Eucharitinae deposit clusters of 80 to 10,000 eggs into preexisting cavities within flower or leaf buds, and rarely into fruits or scattered over the leaf surface; their hosts in the New World are restricted to Ponerinae or Formicinae.

Fauna. Eucharitidae are worldwide, but only a few genera are shared between the Old and New World. The Nearctic fauna is a result of northern extensions of a primarily Neotropical fauna. Eucharitids are mainly tropical and subtropical in distribution, although species of *Pseudochalcura* occur as far north as Yukon Territory and Alaska. *Pseudometagea* is the only genus confined to the Nearctic region.

Literature. Bouček (1988) and Heraty (1994) treated the classification of Oraseminae and Eucharitinae on a world basis. Gahan (1940) revised the Oraseminae for the New World and Heraty (1985, 1986) revised the Eucharitinae for the Nearctic region. Several reviews on eucharitid biology have included species from the Nearctic region (Clausen 1940*a*, *b*, 1941; Johnson et al. 1986; Heraty and Darling 1984; Heraty and Barber 1990; Heraty 1994).

Use of key. The scope of this study includes Canada, United States, and northern Mexico. The genus *Isomerala* is included because it occurs in Mexico within the limits of the Nearctic region, but it should probably be considered as strictly Neotropical.

Key to genera of Eucharitidae

1 Prepectus completely separated from pronotum and reaching tegula (Fig. 2); flagellum with distinct anellus (Fig. 3); head and mesosoma usually metallic green or blue; Gs_1 constricted basally by transverse crenulate furrow; ovipositor stylets subapically expanded and strongly ridged (Figs. 1, 2) .... ORASEMINAE, ***Orasema*** Cameron

Key: Gahan (1940). **Fauna**: 14 spp., transcontinental, extending north into Canada (AB, MB, ON). **Hosts**: mostly *Pheidole*, *Solenopsis* and *Leptothorax* (all Myrmicinae), but 1 sp. from *Formica* (Formicinae). **Oviposition**: into leaves or flower buds of many plants.

– Prepectus fused with pronotum (Figs. 6–8); flagellum without basal anellus (Figs. 4, 6, 8); head and mesosoma yellow, brown, or black, sometimes with faint metallic color; Gs_1 smooth or longitudinally striate, without median transverse furrow (Fig. 5); ovipositor stylets needle-like, without ridges or with only slightly raised ridges (Fig. 5) .... EUCHARITINAE, 2

2(1) Prepectus reaching tegula, sometimes distinguished from pronotum by shallow furrow (Fig. 7); occiput broadly concave; metapleuron distinct from propodeum; funicle with segments cylindrical; Gs_1 often produced forward below petiole; petiole cylindrical or globose medially (Fig. 5) .... ***Pseudometagea*** Ashmead

Key: Heraty (1985). **Fauna**: 8 spp. **Hosts**: *Lasius* (Formicinae). **Oviposition**: into flower buds or seed heads.

– Prepectus not reaching tegula (Figs. 6, 8) and not distinguished from pronotum by furrow; occiput flat; metapleuron indistinct; funicle with segments variously shaped, if cylindrical then mesosoma patterned yellow and brown and scutellum with short apical spines (Figs. 8, 11); Gs_1 not expanded or produced forward; petiole cylindrical, not globose 3

3(2) Scutellum with apex rounded (Fig. 10); postgenae fused behind mandibles. *Female*: funicle with segments slightly lobed to serrate. *Male*: funicle with segments 1–5 or 1–7 branched (Fig. 4) .... ***Pseudochalcura*** Ashmead

Key: Heraty (1986). **Fauna**: 3 spp., 2 in USA (southern FL), and the widespread *P. gibbosa* (Provancher). **Hosts**: *Camponotus* (Formicinae).

– Scutellum with apex produced into paired spines (Figs. 11–13); postgenae broadly or narrowly separated, but not fused medially. *Female*: funicle with segments cylindrical to serrate. *Male*: funicle with segments either cylindrical or all segments with elongate branch 4

4(2) Scutellum with spines as long as mesosoma and broadly separated at base (Fig. 13); mesosoma strongly elevated above dorsal margin of head (Fig. 6). *Male*: funicle with segments each having elongate narrow branch 5

– Scutellum with spines much shorter than length of scutellum and narrowly separated at base (Figs. 11, 12); mesosoma globose, rounded above dorsal margin of head. *Male*: funicle with segments cylindrical or branched, but if branched then branches broad and flattened 6

5(4) Eye broadly rounded (Fig. 13) .... ***Kapala*** Cameron

Fauna: 3 or 4 spp., in USA (AZ and southeastern states) and Mexico. **Hosts**: *Odontomachus* (Ponerinae). **Oviposition**: into flower buds of Asteraceae and Fagaceae.

– Eye nipple-shaped and strongly produced (Fig. 9) .... ***Isomerala*** Cameron

Fauna: 1 sp., *I. coronata* Westwood, in Mexico. **Hosts**: *Ectatomma* (Ponerinae).

6(4) Head black or dark bluish-green, rest of body yellow to orange with brown to black patterns; funicle with segments cylindrical (Fig. 8); scutellum with apical spines only slightly longer than broad (Fig. 11) .... ***Obeza*** Heraty

Key: Heraty (1985). **Fauna**: 2 spp., in USA (AZ and southeastern states) and Mexico. **Hosts**: *Camponotus* (Formicinae). **Oviposition**: into small fruits of Boraginaceae and Ericaceae.

– Head and rest of body black. *Female*: funicle with segments lobed. *Male*: funicle with segments each having long flat branch; scutellum with apical spines more than twice as long as broad (Fig. 12) .... ***Lophyrocera*** Ashmead

Fauna: 1 sp., *L. apicalis* Ashmead, in western USA. **Hosts**: probably *Camponotus* (Formicinae).

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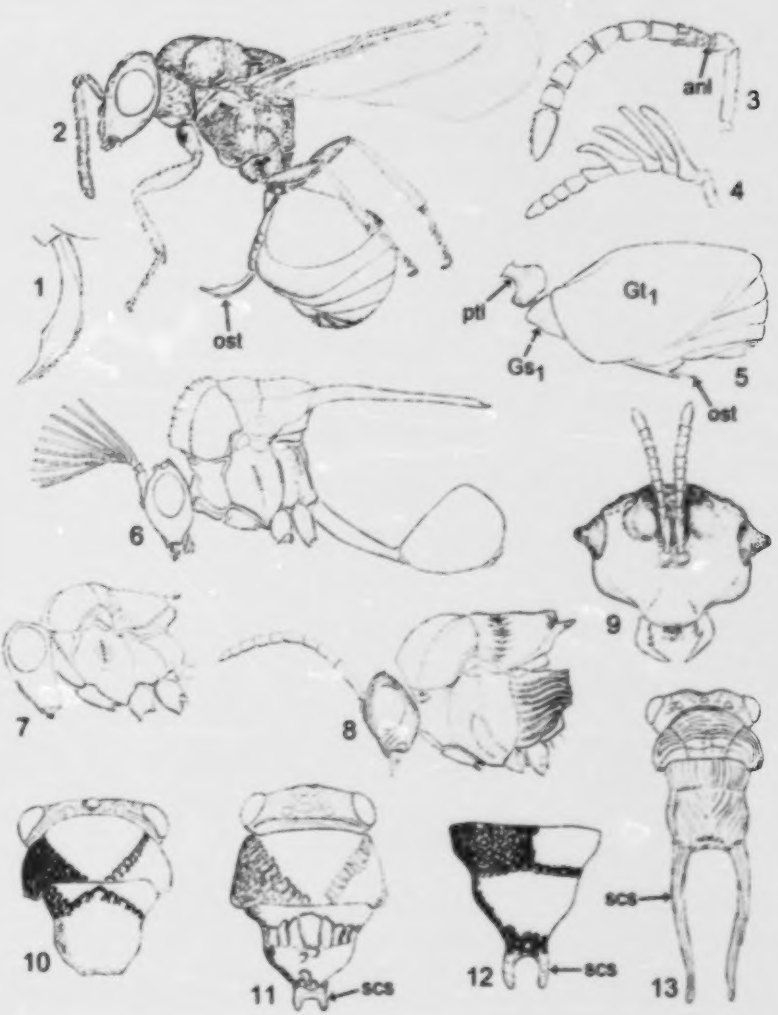

Figs. 1–13. 1–3, ***Orasema violacea*** (Ashmead) ♀: 1, ovipositor stylets; 2, body; 3, antenna. 4, ***Pseudochalcura gibbosa*** (Provancher), ♂ antenna. 5, ***Pseudometagea schwarzii*** (Ashmead), ♀ metasoma. 6, ***Kapala floridana*** (Ashmead), ♂ body. 7–8, ♀ head and mesosoma: 7, ***P. schwarzii***; 8, ***Obeza floridana*** (Ashmead). 9, ***Isomerala coronata*** (Westwood), ♀ head. 10–11, ♀ head and mesosoma: 10, ***P. gibbosa***; 11, ***O. floridana***. 12, ***Lophyrocera apicalis*** Ashmead, scutellum. 13, ***K. floridana***, head and mesosoma. (Abbreviation: scs = scutellar spine.)

Chapter 10. **EULOPHIDAE**

Michael E. Schauff, John LaSalle, and Lonny D. Coote

Recognition. Members of Eulophidae are recognized by their 4-segmented tarsi and short, straight protibial spur. Other features that help to distinguish Eulophidae are: flagellum usually with 2–4 funicular segments (rarely 1 or 5); gaster constricted anteriorly, not broadly attached to mesosoma; axilla often produced anterior to scutoscutellar suture; marginal vein often relatively long; and body small to moderately large (0.4–6.0 mm), but only rarely longer than 3 mm. Members of only one other family, the Elasmidae, have 4-segmented tarsi and a short, straight protibial spur, but elasmids are sufficiently distinct so as not to be confused easily with eulophids. Elasmids have a large and flattened metacoxa, the basitarsus of the metatarsus at least two-thirds as long as the metatibia, and the metatibia distinctly patterned with short, dark setae in the form of apparently closed cells or wavy lines (see chapter 7).

Systematics. Eulophidae appear to be closely related to Elasmidae and Trichogrammatidae, although no definitive studies substantiate this relationship. In these three families the number of tarsal segments is reduced (4-segmented in eulophids and elasmids, 3-segmented in trichogrammatids) and members have a short, straight protibial spur. Elasmids and trichogrammatids possibly evolved from eulophids. Elasmidae have sometimes been treated as a subfamily of the Eulophidae (Burks 1979) but are treated here as a separate family. Eulophidae are composed of four subfamilies, the Entedoninae, Euderinae, Eulophinae, and Tetrastichinae, all of which occur in North America. Diagnostic features and additional information on each subfamily are given below.

ENTEDONINAE. Members are characterized by: scutellum with 1 pair of setae, submarginal vein with 2 setae, and frontofacial sutures when present separated from the anterior ocellus by at least one-third the distance from ocellus to torulus. With a little practice, the majority of individuals are easily recognizable as Entedoninae. In some genera (e.g., *Entedon*, *Pediobius*, *Horismenus*) the body is rather strongly sclerotized, but in other genera (e.g., *Omphale* or *Chrysocharis*) the body is weakly sclerotized and specimens often shrivel badly after death.

EUDERINAE. There are 19 recognized genera of Euderinae worldwide. It is the smallest subfamily in the Nearctic region, with four of the six genera represented by only one or two species. Females are recognized by Gt_7 and Gt_8

being separated from each other anterior to the cerci so that 8 distinct gastral terga are visible. All other eulophids have Gt_7 and Gt_8 fused into a syntergum, so only 7 gastral terga are visible. Males are sometimes difficult to identify as Euderinae, but in both sexes of all genera the scutellum lacks submedian grooves, and the mesoscutum has notauli that are usually straight, deep, and complete (although sometimes difficult to see posteriorly and absent anteriorly in *Hubbardiella*). In addition, in all Nearctic genera the upper surface of the forewing has a bare area behind the marginal vein extending from the parastigma to the stigmal vein, through which can be seen a row of ventral admarginal setae that are often long. This area of the forewing is usually densely setose in other subfamilies and in some non-Nearctic euderines, but in the genera of euderines treated here, admarginal setae are always present; a few members of other subfamilies can also have a distinct row of admarginal setae and a more or less bare area behind the marginal vein. Most Nearctic genera have the forewing with distinct lines of setae, especially radiating from the stigma. Other useful features for recognition include: scutellum with 2 or 3 pairs of setae, or several scattered setae; axilla usually distinctly advanced; and postmarginal vein as long as or longer than stigmal vein.

EULOPHINAE. The Eulophinae appear to be the most primitive subfamily because they have less-specialized features. Members have the submarginal vein smoothly joining the parastigma; a long postmarginal vein (usually longer than the stigmal vein); and the dorsal surface of the submarginal vein with 3 or more setae. A different state of any of these characters will usually indicate one of the other subfamilies.

The Eulophinae have previously been treated as two subfamilies (Peck et al. 1964, Burks 1979): Eulophinae (notauli incomplete and funicle of males usually with 2–3 branches) and Elachertinae (notauli complete and funicle of males never branched). These features do not separate all species and the subfamilies have since been united (Graham 1987, Bouček 1988). Three tribes are considered to occur in the Nearctic Region: Eulophini, Euplectrini, and Elachertini (Schauff and LaSalle 1993).

TETRASTICHINAE. This is the largest subfamily, and its species are widespread and common. The majority of species are recognized by the following combination of features: scutellum with submedian and sublateral grooves, and postmarginal vein greatly reduced (less than half the length of the stigmal vein) or absent. Small body size, uniform morphology, and a tendency for specimens to shrivel upon death make this an extremely difficult group to study. Because of this, most species were classified in the genus *Tetrastichus* (e.g., Burks 1943); however, *Tetrastichus* has since been divided into several, more natural groups (Graham 1987, 1991; Bouček 1988; LaSalle 1994). The largest genus in all regions is *Aprostocetus*, with many hundreds of species. Next in size is *Baryscapus* (= *Eutetrastichus* Kostjukov, in Graham 1987), which is mainly Holarctic in distribution, and then *Tetrastichus* and *Quadrastichus* Girault (= *Cecidotetrastichus* Kostjukov, in Graham 1987), both of which are cosmopolitan.

Biology. Eulophidae display a remarkable degree of diversity in their biologies. They are predominantly parasites of Lepidoptera, Coleoptera, Diptera, and Hymenoptera; however, many other hosts are used. A great many eulophids are parasites of hosts concealed in plant tissue, such as leaf miners, wood borers, leaf rollers, and gall formers.

Entedoninae and Tetrastichinae attack a wide variety of hosts, whereas Eulophinae and Euderinae are relatively limited in their host preferences. Tetrastichinae, in particular, are exceptional in their host range, parasitizing over 100 families of hosts in 10 insect orders as well as eggs of spiders (Araneae), mites (Acari), and nematodes (Nematoda) (LaSalle 1994). In the last three cases the eulophid larva does not behave as a true parasite, but acts as a predator by consuming several host individuals (within the spider egg sac or within galls). Additionally, Eulophidae (Tetrastichinae) contain phytophagous species, including gall-formers, seed predators, and inquilines.

In addition to a wide host range, the family shows a wide range of biological attributes. Species of Euplectrini (Eulophinae) are gregarious ectoparasites of Lepidoptera larvae and are unique among the Chalcidoidea in forming silk cocoons that are attached to the outside of their prey (Clausen 1940). They are also able to cause developmental arrest of the caterpillar by injecting a substance that stops it from molting. This prevents the caterpillar from casting off its dead skin and any attached parasite larvae. Species of *Melittobia* (Tetrastichinae) are mainly gregarious parasites of Aculeata. Males have short, non-functional wings and vestigial eyes, and their sole purpose seems to be mating. They emerge before the females and wait by the exit hole to mate with the females as they emerge. Males of some species are aggressive in their efforts to monopolize females and will decapitate unemerged male pupae or freshly emerged males (Dahms 1984*b*).

Hyperparasitism is quite common in some groups, particularly in Entedoninae and Tetrastichinae. Many of these species appear to be facultative rather than obligatory hyperparasites. Gregarious parasitism occurs in several genera. Some Eulophidae are aquatic, e.g., one species of *Horismenus* (Entedoninae) parasitizes the prepupae of Psephenidae (Coleoptera) under water (Burks 1968

— as *Psephenivorus*), several species of *Aprostocetus* (subgenus *Ootetrastichus*) (Tetrastichinae) parasitize the eggs of Odonata or Dytiscidae (Coleoptera) in plant stems under water (Fursov and Kostjukov 1987 — as *Tetrastichus*), and adult females have been seen to swim under water to reach their prey (V. Kostjukov, V. Fursov, personal communication).

Many species of Eulophidae are economically important and the family ranks third among Chalcidoidea, after Aphelinidae and Encyrtidae, in the number of species used in biological control. Of particular note are the genera *Pediobius, Chrysocharis, Diglyphus, Edovum, Oomyzus*, *Tetrastichus*, and *Closterocerus*. *Pediobius foveolatus* (Crawford) has been used to control Mexican bean beetle, *Epilachna varivestis* Mulsant, in the United States (Stevens et al. 1975). *Edovum puttleri* Grissell has been used extensively in biocontrol programs against the Colorado potato beetle, *Leptinotarsa decemlineata* (Say) (Shroeder et al. 1985). Several species of *Chrysocharis* and *Diglyphus* have been used to control leaf-mining Diptera and Lepidoptera (see Graham 1949, and Hendrickson and Barth 1979). *Closterocerus ruforum* (Krausse) was imported into North America for biological control of Diprionidae (Hymenoptera) and several authors have reported on its biology (see Bouček and Askew 1968, as *Achrysocharis ruforum*). Species of *Oomyzus* have been used against various Coleoptera, and *O. sokolowskii* Kurdjumov, although a facultative hyperparasite, has shown potential in the control of diamond-back moth, *Plutella xylostella* (L.). Species of *Tetrastichus* have been used in biological control projects against Diptera, Coleoptera, and Lepidoptera.

Little is known about the immature stages of eulophids. The eggs are usually elongate, oval or kidney-shaped (Askew and Ruse 1974), but may also be longer with an anterior filament (Viggiani 1971). There are from 3 to 5 larval instars. The first instar is hymenopteriform, with 13 segments, and may have fleshy tubercles or rows of spines on the body. The mature larva is generally not hairy.

Mating behavior has been studied in several species, including detailed studies of *Melittobia* (see references below). Mating behavior can be quite complex and may be useful in assessing relationships in some groups (see Assem et al. 1982*a*, 1982*b*, and Bosch and Assem 1986).

Biological attributes of some of the genera within each subfamily are summarized below.

ENTEDONINAE. Entedoninae is a large group that contains many species of economic importance. Members are mostly endoparasites of the eggs or young larvae of Coleoptera, Lepidoptera, and Diptera developing within plant tissue. A small group of genera (*Ceranisus*, *Entedonastichus*, *Goetheana*, *Thripobius*) are parasites of Thysanoptera, and another group of genera related to *Euderomphale* are parasites of Aleyrodidae (Homoptera). Species of *Chrysocharis*, *Closterocerus*, and *Neochrysocharis* parasitize mainly leaf-mining Coleoptera, Diptera, and Lepidoptera, apparently specializing on a niche more than a host group. Species of *Entedon* are parasites of small Coleoptera, mainly Curculionidae, and species of *Omphale* mainly parasitize gall-forming Cecidomyiidae (Diptera). Species of *Pediobius* attack a wide range of hosts, mostly Lepidoptera, Coleoptera, Diptera, and Hymenoptera, but also such varied hosts as egg sacs of spiders (Araneae), Thysanoptera, and egg cases of Mantidae (Mantodea). Several species of *Pediobius* and *Horismenus* are hyperparasites.

EUDERINAE. Some Nearctic species of *Euderus* are primary parasites of leaf-tying, leaf-mining, twig-boring, and fruit-boring Lepidoptera, stem-boring Coleoptera, and gall-making Hymenoptera. Other species are hyperparasites of Hymenoptera that parasitize Lepidoptera. Nearctic species of *Astichus*, and possibly also of *Allocerastichus*, parasitize Coleoptera that live in bracket fungi. The single Nearctic species of *Acrias* possibly parasitizes a species of leaf-tying Lepidoptera.

EULOPHINAE. Members of the Euplectrini (main genus *Euplectrus*) are characterized by an elongate metatibial spur; all are gregarious ectoparasites of Lepidoptera. The larvae spin characteristic silk cocoons that are attached to the host's body. Most members of the other two tribes are parasites of insects boring in or mining plant tissue and show various degrees of specialization. Certain genera (*Elachertus*, *Trichospilus*, *Sympiesis*, *Hyssopus*) specialize on Lepidoptera. Other genera (*Zagrammosoma*, *Hemiptarsenus*, *Pnigalio*) parasitize leaf miners of several orders, including Lepidoptera, Coleoptera, Diptera, and Hymenoptera. Species of *Cirrospilus* attack a wide range of insects concealed within plant tissue, e.g., leaf miners, leaf rollers, and gall formers, and *Aulogymnus* are parasites within galls. Species of *Diglyphus* are parasites of leaf-mining Diptera; several species have been used in biological control programs against economic pests (e.g., *Liriomyza*), including pests in greenhouses (Minkenberg and Lenteren 1986).

TETRASTICHINAE. Although identification of species and genera within this subfamily is often difficult and tedious, biologically this is one of the most interesting groups of Chalcidoidea. Hosts of Tetrastichinae include members of 100 families of insects in 10 different insect orders, plus mites, spider eggs, and even nematodes. In addition, this subfamily includes species that are phytophagous or gall formers. Many species of *Aprostocetus* are parasites of Cecidomyiidae (Diptera) or other gall-forming insects, others are parasites of eggs, larvae, or pupae of various insects, and many species are hyperparasites. Species of *Melittobia* are gregarious parasites of some Aculeata (Hymenoptera) and species of the closely related *Tachinobia* are parasites of the puparia of Diptera (mostly Tachinidae). In both these genera the females are fully winged, but the males have both the wings and eyes reduced. Species of *Tamarixia* are parasites of Psylloidea (Homoptera). Some tetrastichines have specialized on galls, apparently through niche rather than host preference, and can be parasites, inquilines, plant feeders, or gall formers (LaSalle 1994).

Fauna. Eulophidae are cosmopolitan in distribution, with about 3,400 described species in 280 genera worldwide (Grissell and Schauff 1990) and about 600 described species in 110 genera in the Nearctic region. Eulophids are generally abundant and are probably the most commonly collected chalcidoids in all biogeographic regions.

Literature. Major changes to either eulophid nomenclature or to generic limits have been made in some recent papers: Schauff and LaSalle (1993) changed the application of several North American genera and Hansson (1994*a*, 1994*b*, 1995*a*, 1996*a*, 1996*b*) revised the concept of some important genera such as *Closterocerus*, *Neochrysocharis*, *Chrysonotomyia*, *Teleopterus*, *Asecodes*, *Ionympha*, and *Omphale*. Graham (1987, 1991) revised and keyed the European genera and species of Tetrastichinae. LaSalle (1994) keyed the North American genera of Tetrastichinae and included information on hosts, use in biological control, synonymy, and a list of included species. Schauff (1991) keyed the Holarctic genera of Entedoninae. Schauff (1991) and LaSalle and Schauff (1990) gave nomenclatural notes on some eulophid genera, including transfer of genera among the subfamilies. Coote (1994) reviewed and keyed the Nearctic genera of Euderinae. Miller (1970) keyed the North American genera of Eulophini (as Eulophinae), but this does not include several genera. Burks (1943) keyed the North American species of what was then classified as *Tetrastichus*.

Few keys to genera are available for regions other than Europe and North America. Bouček (1988) keyed the Australasian genera of the family. Although there are no keys to the Neotropical region, LaSalle and Schauff (1992) provided extensive nomenclatural notes on the genera and species described by Ashmead, Cameron, Howard, and Walker.

Use of key. The Nearctic Region is treated primarily as that area north of Mexico.

Key to genera of Eulophidae

1 Scutellum with 1 pair of setae (Fig. 257); submarginal vein with 2 setae on dorsal surface (Figs. 280, 281); notauli usually incomplete or absent; head with transverse frontofacial suture, when present, separated from anterior ocellus by at least one-third distance between anterior ocellus and torulus (Fig. 243) ...... ENTEDONINAE (part), 106

– Scutellum usually with 2 pairs of setae (Figs. 36, 166), occasionally with more than 2 pairs or, more rarely, with numerous irregularly scattered setae (Fig. 2); submarginal vein usually with at least 3 setae on dorsal surface or, if with 1 or 2 setae (some Tetrastichinae), notauli present and complete; head with transverse frontofacial suture, when present, adjacent to anterior ocellus (Fig. 91) 2

2(1) Notauli absent or incomplete posteriorly and not approaching posterior margin of mesoscutum or axillae (Fig. 167) 3

– Notauli present and either reaching posterior margin of mesoscutum or curving to meet axillae (Figs. 35, 165) 4

3(2) Funicle 1- or 2-segmented (Figs. 294, 296) **and** pronotum and dorsellum in dorsal view not visible (Fig. 274); mesosoma **either** with many scattered setae on scutellum and dorsum of mesosoma reticulate **or** scutellum with 2 pairs of setae, dorsum of mesosoma relatively smooth, and axillae large and mainly anterior to scutoscutellar sutures (Fig. 276); scutellum without submedian grooves; parasites of Aleyrodidae ...... ENTEDONINAE (part), 106

– Funicle at least 3-segmented (Figs. 180, 184), **or** pronotum and/or dorsellum in dorsal view clearly visible (Figs. 165, 173), **or** scutellum with submedian grooves; not parasites of Aleyrodidae ...... EULOPHINAE (part), 8

4(2) Wings absent or reduced, extending less than half length of gaster 5

– Wings of normal size, usually extending at least half length of gaster 6

5(4) *Female only*: funicle 4-segmented .... EULOPHINAE (part), 8

– *Male* or, *if female*, funicle 3-segmented .... TETRASTICHINAE (part), 46

6(4) *Both sexes*: forewing behind marginal vein usually with bare area extending from parastigma to stigmal vein except for distinct row of admarginal setae on underside of wing (Figs. 208, 209), and usually with 2–3 rows of setae radiating from stigmal vein **or**, if forewing without rows of setae, **then** antenna of male different from female, nodose with whorls of long setae (Figs. 216, 217); postmarginal vein usually as long as or longer than the often relatively short stigmal vein; scutellum without submedian grooves; funicle 4- or, rarely, 5-segmented. *Female*: Gt_7 separated from Gt_8 anterior to cerci (Figs. 211, 212), the gaster with 8 distinct segments. [**Note**: it is uncertain if Gt_7 and Gt_8 are fused in the only known female of *Hubbardiella* (see Coote 1994).] .... EUDERINAE, 41

– *Both sexes*: forewing different, if with bare area behind marginal vein then without rows of setae radiating from stigmal vein and antenna of male similar to female, without whorls of long setae; postmarginal vein variable, but often rudimentary or absent; scutellum often with submedian or sublateral grooves. *Female*: Gt_7 and Gt_8 fused into syntergum, the gaster with 7 visible segments; funicle 2–4-segmented 7

7(6) Postmarginal vein usually absent, rudimentary, or at most half length of stigmal vein (Figs. 134, 135) (see note below); submarginal vein usually broken or narrowed apically and not smoothly joining parastigma; axilla usually strongly advanced, defining a linear or almost linear scapular flange; scutellum often with submedian grooves (Figs. 25, 26). *Female*: funicle 3-segmented. *Male*: funicle 4-segmented. [**Note**: a few genera have the postmarginal vein over half the length of the stigmal vein, but they always have the submarginal vein not smoothly joining the parastigma and the axilla advanced.] .... TETRASTICHINAE (part), 46

– Postmarginal vein at least as long as stigmal vein and usually longer (Fig. 200); submarginal vein smoothly joining parastigma; axilla not so strongly advanced, the lateral lobe without a linear scapular flange; scutellum with or without submedian grooves; funicle 2–4-segmented .... EULOPHINAE (part), 8

8(3, 5, 7) *Female only*: short winged, the wings extending less than half length of gaster .... ***Xanthellum*** Erdös & Novicky (part)

Note: males of *Xanthellum* will key to *Elachertus*.

Fauna: 1 sp., *X. transsylvanicum* Erdös (1951), in Canada (ON) and USA (MA) (see Schauff and LaSalle 1993). **Hosts**: *Coleophora mayrella* (Hübner) (Coleophoridae).

– *Both sexes*: fully winged 9

9(8) Metatibia with at least 1 and often both spurs distinctly longer than basitarsus (Fig. 189) 10

– Metatibia with both spurs normal, not longer than basitarsus 12

10(9) Scutellum without sublateral grooves (Fig. 162); pronotum with anterior margin usually having distinct transverse carina .... ***Euplectrus*** Westwood

Fauna: 13 spp., widespread. **Hosts**: Lepidoptera.

– Scutellum with distinct sublateral grooves; pronotum not distinctly carinate 11

11(10) Propodeum with median carina divided into 2 submedian carinae, these sometimes appearing H- or X-shaped (Fig. 163) .... ***Euplectromorpha*** Girault

Fauna: 1 undescribed sp. in USA (FL). **Hosts**: *Alarodia slossoniae* (Packard) (Limacodidae).

– Propodeum with simple median carina, sometimes Y-shaped or cup-shaped anteriorly .... ***Platyplectrus*** Ferrière

Fauna: 1 sp., *P. americana* (Girault), in USA (MD) (see Schauff and LaSalle 1993).

12(9) Funicle 2-segmented (Fig. 185) 13

– Funicle 3- or 4-segmented (Figs. 180, 181, 187) 19

13(12) Torulus close to mouth margin, separated from anterior ocellus by at least three times distance from torulus to mouth margin (Fig. 192); forewing with areas of darkened and thickened setae or dark spots behind venation (Fig. 198); scutellum without submedian grooves; body yellow to brown, non-metallic .... ***Trichospilus*** Ferrière

Fauna: 1 sp., *T. diatraeae* Cherian & Margabandhu, in USA (FL) (apparently introduced from southern Asia; for discussion of New World distribution see Bennett et al. 1987). **Hosts**: pupae of Lepidoptera.

– Torulus usually in middle of face or only slightly closer to margin of mouth (Fig. 193), but if separated from anterior ocellus by less than twice distance from torulus to mouth margin (e.g., *Colpoclypeus*) then forewing usually hyaline, or occasionally with darkened areas but then without dark setae; scutellum with or without submedian grooves; body color variable, often metallic but sometimes yellow to brown (not metallic) 14

14(13) Notauli incomplete (Figs. 167, 190); body with at least head and mesosoma metallic 15

– Notauli complete (Figs. 165, 191), either continuing to posterior margin of mesoscutum or curving to meet axillae; body color variable, metallic or non-metallic 16

15(14) *Female only*: scutellum without submedian grooves; clypeus bilobed .... ***Colpoclypeus*** Lucchese (part)

Fauna: 1 sp., *C. florus* (Walker), in USA (WA) (widespread in Europe). **Hosts**: leaf-mining Tortricidae.

– *Both sexes*: scutellum with submedian grooves; clypeus entire .... ***Diglyphus*** Walker

Key: Gordh and Hendrickson (1979). **Fauna**: 6 spp. **Hosts**: leaf-mining Diptera.

16(14) Notauli curving to meet anterior portion of axillae (Fig. 191); vertex vaulted, extending distinctly above upper margin of eye (Fig. 164); body yellow and black, or black, never metallic; forewing often with darkened areas .... ***Zagrammosoma*** Ashmead

Keys: Gordh (1978) and LaSalle (1989). **Fauna**: 11 spp. **Hosts**: leaf-mining Lepidoptera and Diptera.

– Notauli straight, extending to anterior margin of scutellum (Fig. 165); vertex not extending distinctly above upper margin of eye (Fig. 193); body and wing color variable 17

17(16) Postmarginal vein about twice as long as stigmal vein (Fig. 202). *Male*: scape enlarged (Fig. 182) .... ***Diaulinopsis*** Crawford

Key: Gordh and Hendrickson (1979). **Fauna**: 2 spp. **Hosts**: leaf-mining Diptera.

– Postmarginal vein equal to or shorter than stigmal vein (Fig. 201). *Male*: scape seldom enlarged 18

18(17) Scutellum relatively convex, without submedian grooves or with grooves only faintly indicated by change in sculpture (Fig. 165); stigma distinctly elongated, with uncus separated from apex (Fig. 204) .... ***Aulogymnus*** Förster (part)

Fauna: 5 spp. **Hosts**: gall-forming insects. (See Schauff and LaSalle 1993.)

– Scutellum relatively flat, with submedian grooves, though grooves often difficult to see due to changes in color pattern; stigma rounded, with uncus at apex (Fig. 203) .... ***Cirrospilus*** Westwood

Fauna: 24 spp. **Hosts**: a variety of hosts hidden in plant tissue, such as leaf mines, leaf rolls, and galls.

19(12) Notauli incomplete (Fig. 190). *Male*: funicle often with long branches (Figs. 183, 186) 20

– Notauli complete, but sometimes fine (Figs. 166, 174). *Male*: funicle without or only rarely with long branches 30

20(19) Scutellum and mesoscutum with setae scattered evenly over entire surface (Fig. 177); flagellum with 2 claval and 4 funicular segments, the funicular segments all quadrate to wider than long; propodeum medially only slightly longer than dorsellum .... ***Dasyeulophus*** Schauff & LaSalle

Fauna: 1 sp., *D. gelechiae* (Miller), in USA (AL, AZ, KS) (See Schauff and LaSalle 1993). **Hosts**: Gelechiidae.

– Scutellum with paired setae (usually 2 or 3 pairs) (as in Fig. 166) and mesoscutum with setae either paired or scattered over entire surface; flagellum usually with 3 claval segments and 3 or 4 funicular segments, the funicular segments variable but often distinctly longer than wide; propodeum medially usually distinctly longer than dorsellum 21

21(20) Funicle 3-segmented (Figs. 180, 181) 22

– Funicle 4-segmented (Fig. 184) 25

22(21) Scutellum with submedian grooves. *Male*: funicle with 2 long branches (Fig. 183) .... ***Dicladocerus*** Westwood

Key: Yoshimoto (1976). **Fauna**: 13 spp. **Hosts**: Lepidoptera.

– Scutellum without submedian grooves. *Male*: funicle either without branches or with 3 branches (Fig. 186) 23

23(22) *Male only*: clypeus bilobed; funicle with 3 unbranched segments .... ***Colpoclypeus***, see 15

– *Female* or, *if male*, clypeus entire and funicular segments with long branches 24

24(23) Basitarsus, at least of mesotarsus, distinctly shorter than second tarsal segment; mandibles reduced, not meeting medially (Fig. 171) .... ***Eulophus*** Geoffroy

Fauna: 9 spp. **Hosts**: gregarious parasites of Lepidoptera, the pupae often found clustered on leaves and arranged around remains of host.

– Basitarsus of all tarsi longer than second tarsal segment; mandibles normal, meeting medially (Fig. 169) .... ***Necremnus*** Thomson

Note: the European genus *Microlycus* Thomson is extremely similar to *Necremnus*, but is separated by characters given in Bouček (1959). The genus has not as yet been recorded from North America, but specimens that might belong to it are in the USNM. Generic limits need to be determined.

Fauna: 9 spp. **Hosts**: Lepidoptera and Coleoptera.

25(21) Propodeum with complete plica and a transverse costula extending from each plica to median carina (Fig. 156), the area between the plicae smooth and shiny .... ***Pnigalio*** Schrank

Keys: Miller (1970) and Yoshimoto (1983). **Fauna**: 17 spp. **Hosts**: mainly leaf-mining Lepidoptera, Coleoptera and Diptera, and also gall-forming Tenthredinidae.

– Propodeum without costula and usually without plica (Fig. 157), but if plicae present then area between them distinctly reticulate 26

26(25) Torulus high on head, above lower margin of eye, hence apex of scape extending above level of vertex (Fig. 197); forewing and costal cell long and narrow, the forewing at least 2.6 times as long as wide and costal cell 10–15 times as long as wide .... ***Hemiptarsenus*** Westwood

Fauna: 7 spp. (see Schauff and LaSalle 1993). **Hosts**: leaf miners (mostly Diptera).

– Torulus at or below lower margin of eye, hence apex of scape not extending above level of vertex (Fig. 193); forewing and costal cell not so long and narrow, the forewing less than 2.6 times as long as wide and costal cell less than 10 times as long as wide 27

27(26) Clypeus with anterior margin distinctly bilobed (Fig. 170) .... ***Dimmockia*** Ashmead

Key: Ikeda and Huber (1996). **Fauna**: 3 spp. **Hosts**: generally hyperparasites of Lepidoptera through Hymenoptera, occasionally primary parasites.

– Clypeus with anterior margin straight (Fig. 168) 28

28(27) *Female*: flagellum somewhat flattened and becoming wider apically (Fig. 187); scape, mesocoxa, and metacoxa white. [**Note**: males cannot be distinguished from *Sympiesis* by these features.] .... ***Dahlbominus*** Hincks

Fauna: 1 sp., *D. fuscipennis* (Zetterstedt), introduced from Europe, and at least 1 undescribed sp. in southeastern USA. **Hosts**: Diprionidae.

– *Female*: flagellum cylindrical or only slightly flattened, the segments usually about same width (Fig. 184); scape and coxae dark or metallic 29

29(28) Propodeum laterally with distinct step-like plica, hence area between plicae on slightly higher level than area lateral to plicae .... ***Notanisomorphella*** Girault

Fauna: 1 undescribed sp. in USA (WV). **Hosts**: *Coleophora malivorella* Riley (Coleophoridae). (See Schauff and LaSalle 1993.)

– Propodeum without plica (Fig. 172)...................... ***Sympiesis*** Förster

Key: Miller (1970) (see also Schauff and LaSalle 1993). **Fauna**: 17 spp. **Hosts**: leaf-mining Lepidoptera.

30(19) Submedian grooves sinuate, converging medially (Fig. 158); propodeum with median carina bifurcating posteriorly, forming large cell or areola above petiolar insertion (Figs. 158, 196). *Female*: funicle usually 3-segmented. *Male*: funicle 4-segmented .... ***Deutereulophus*** Schulz

Fauna: at least 3 undescribed spp. (see Schauff and LaSalle 1993).

– Submedian grooves absent or, if present, straight and not converging medially (Figs. 174, 176); propodeum with median carina not defining posterior cell or areola (Fig. 172); funicle with same number of segments in each sex 31

31(30) Funicle 3-segmented; stigmal vein with stigma distinctly elongate and uncus separated from its apex (Fig. 204) .... ***Aulogymnus***, see 18

– Funicle 4-segmented (as Fig. 184); stigmal vein with stigma rounded and uncus near its apex (Fig. 203) 32

32(31) Propodeum medially with 2 strong X- or H-shaped carinae (Fig. 161) .... ***Stenomesius*** Westwood

Note: Schauff and LaSalle (1993) removed both North American species previously assigned to *Stenomesius*. The genus occurs in Central America and the Caribbean and likely also occurs in North America; therefore, we have included it the key. Hosts are Lepidoptera.

– Propodeum without median carina or with single simple carina, the carina sometimes cup-shaped anteriorly (Fig. 175) 33

33(32) Pronotum long and subquadrate, with strong transverse carina on anterior margin (Fig. 178); occipital region with 2 carinae (Fig. 179), a transverse carina on vertex just behind ocelli and a strong, horseshoe-shaped occipital carina .... ***Cristelacher*** Schauff & LaSalle

Fauna: 1 sp., *C. levana* (Walker), in USA (FL, KS) (see Schauff and LaSalle 1993).

– Pronotum generally not long and quadrate, without transverse carina on anterior margin; occipital region smoothly rounded or with 1 carina 34

34(33) Face generally receding sharply below toruli (Fig. 160); forewing with tuft of strong, dark setae near junction of submarginal vein and marginal vein, and disc with distinct dark stripe(s) (Fig. 199); mandibles strongly reduced, without teeth and separated medially; head with strong occipital carina (Fig. 159) .... ***Hoplocrepis*** Ashmead

Fauna: 1 sp., *H. albiclava* Ashmead, in USA (FL), and at least 1 undescribed sp. in USA (MA, VA).

– Face different, generally not receding sharply below toruli; forewing without such tuft of setae and usually hyaline (Fig. 200); mandibles not reduced and usually meeting medially when closed; head without obvious occipital carina 35

35(34) Propodeum with posterolateral margin expanded into broad translucent flange or flap over metacoxa, and with distinct carina extending laterally from above flap to just under spiracle, the carina often flaring into a Y-shape and forming small translucent flange adjacent to spiracle .... ***Xanthellum*** Erdös & Novicky, see 8

– Propodeum with posterolateral margin not expanded or only narrowly expanded into translucent flange over metacoxa, and without lateral carina extending to spiracle 36

36(35) Mandible long and slender, somewhat flattened and protruding away from face, with many small, subequal teeth (Fig. 168); scutellum reticulate (Fig. 166); body yellow, to yellow and brown or black, non-metallic. *Female*: face usually with characteristic transverse white stripe at level of toruli, the stripe bordered above and below by dark stripe (Fig. 194) or sometimes reduced to white spot next to each eye. *Male*: funicle with segments expanded (Fig. 188) ... . ***Paraolinx*** Ashmead

Key: Miller (1964). **Fauna**: 3 described and at least 1 undescribed spp. **Hosts**: Lepidoptera.

– Mandible not so long, usually not protruding or flattened and if with more than 4 teeth then at least first and/or second tooth markedly larger than other teeth (Fig. 169); scutellum and body color variable. *Female*: face without transverse stripe. *Male*: funicle with segments not expanded 37

37(36) Clypeus with anterior margin distinctly produced (Fig. 195); scutellum uniformly reticulate and without distinct submedian grooves; funicle with segments quadrate to wider than long; occiput with small but distinct transverse carina behind ocelli .... ***Grotiusomyia*** Girault

Fauna: 1 sp., *G. flavicornis* Girault, in USA (DC, MO, NC). **Hosts**: Pyralidae on *Quercus* and *Populus*.

– Clypeus with anterior margin not produced, the margin transverse or only slightly rounded (as in Fig. 169); scutellum different, **either** smooth or very lightly sculptured **or** with distinct submedian grooves; funicle usually with at least first segment longer than wide; occiput with or without carina 38

38(37) Scutellum with submedian grooves incomplete or absent, but if present then grooves straight, not curving inward at posterior margin of scutellum (Fig. 174) .... ***Miotropis*** Thomson

Fauna: 8 spp. (see Schauff and LaSalle 1993). **Hosts**: Lepidoptera.

– Scutellum with submedian grooves complete, curving inward at posterior margin of scutellum and meeting or nearly meeting each other (Fig. 175) 39

39(38) Mesoscutum with 4 setae (2 pairs) (Fig. 173); pronotum in dorsal view semiglobose, somewhat elongate and distinctly rounded anteriorly (Fig. 173) .... ***Hyssopus*** Girault

Key: Schauff (1985*b*). **Fauna**: 8 spp. **Hosts**: larvae of Lepidoptera in concealed situations.

– Mesoscutum with at least 6 setae (3 pairs), sometimes with numerous scattered setae; pronotum different, not so elongate or rounded anteriorly (Fig. 166) 40

40(39) Propodeum with plica connected to median carina by irregular costulae (Fig. 205); scutellum often with incomplete median longitudinal line or groove .... ***Diglyphomorpha*** Ashmead

Fauna: 1 sp., *D. aurea* (Howard), in USA (FL) (also Caribbean) (see Schauff and LaSalle 1993).

– Propodeum without plica or costulae; scutellum generally without median longitudinal line .... ***Elachertus*** Spinola

Note: the generic limits of *Elachertus* remain unclear and in our opinion further study is needed, particularly of Neotropical species, to determine whether one or a complex of genera is currently included under this name (see Schauff and LaSalle 1993). Males of *Xanthellum* will key here and we have found no features to separate reliably males of these two genera.

Key: Schauff (1985*a*). **Fauna**: 8 spp. **Hosts**: larvae of Lepidoptera in concealed situations.

41(6) Notauli absent anteriorly, but present as deep grooves posteriorly; mesosoma with scutellum long and in dorsal view completely overhanging dorsellum, the dorsellum and propodeum almost perpendicular to plane of scutellum (Fig. 206); forewing with 2 faintly indicated rows of setae radiating from stigma; mesosoma deeply reticulate .... ***Hubbardiella*** Ashmead

Fauna: 1 sp., *H. arizonensis*, in USA (AZ).

– Notauli complete, though sometimes fine; scutellum at most partly overhanging dorsellum, the dorsellum and propodeum not perpendicular to plane of scutellum; forewing usually with 2 or 3 distinct rows of setae radiating from stigma (Fig. 208); mesosoma shallowly reticulate to alutaceous or subglabrous 42

42(41) Lower face with 1 or 2 vertical grooves between torulus and mouth margin (Fig. 207); head usually vaulted and produced above level of upper margin of eye (Fig. 207); forewing often with stigma enlarged and disc often with darkened areas. *Female*: gaster with last tergum elongate, almost as long as to longer than preceding tergum, covering most of elongate ovipositor sheaths, and compressed or expanded ....***Acrias*** Walker

Fauna: 1 sp., *A. nileus* Walker, in USA (CA, FL, PA, VA) and Mexico. **Hosts**: Lepidoptera.

– Lower face without grooves below each torulus; head not vaulted above level of upper margin of eye; forewing with stigma normal and disc with or without darkened areas. *Female*: gaster with last tergum usually shorter than preceding tergum or, if longer, convex (not compressed or expanded) 43

43(42) Forewing with darkened areas (e.g., Figs. 209, 210), usually in distinct pattern of connected cross-bands; mesosoma and head usually bright metallic (often as contrasting-colored stripes), rarely partly pale yellow. *Female*: funicle usually with at least 1 segment white in contrast to other, brown or black segments .... ***Astichus*** Förster

Keys: Hedqvist (1969) and Yoshimoto (1970). **Fauna**: 5 described and 2 undescribed spp., widespread in region and extending into Mexico. **Hosts**: Ciidae and Tenebrionidae.

– Forewing hyaline; mesosoma and head with color varied, often dull metallic or non-metallic, rarely with colored stripes [*Euderus verticillatus* (Ashmead)]. *Female*: funicle with all segments brown or black 44

44(43) Propodeum alutaceous to reticulate (as in Fig. 218, *Euderus* s. str.), or rugose [Fig. 219, *Euderus* (*Secodelloidea*)] (see note below), and with median carina (carina apparently absent in some species with medially short propodeum); forewing usually with 2 or 3 rows of setae radiating from stigma (Fig. 208, see note below); scutellum partly overhanging dorsellum. *Female*: gaster with last tergum much shorter than preceding tergum (Fig. 211) or, if rarely longer [*E.* (*E.*) *saperdae* Miller], propodeum short medially. *Male*: antenna usually similar to that of female (Fig. 215), though sometimes with funicular segments nodose and with whorls of long setae .... ***Euderus*** Haliday

Note: species with a rugose propodeum were classified in *Secodelloidea* Girault by Bouček (1963, 1988), but as a subgenus of *Euderus* by Yoshimoto (1971). Species without rows of radiating setae in the forewing and with the female pedicel and first funicular segment at least twice as long as wide were classified in *Parasecodella* Girault by Bouček (1988) (see Coote 1994).

Key: Yoshimoto (1971). **Fauna**: at least 25 spp., widely distributed. **Hosts**: primary parasites of Lepidoptera (Argyresthiidae, Coleophoridae, Gelechiidae, Pyralidae, Tortricidae), Coleoptera (Buprestidae, Cerambycidae, Curculionidae), and Hymenoptera (Cynipidae), and secondary parasites of Lepidoptera through Hymenoptera (Braconidae, Ichneumonidae).

– Propodeum alutaceous to glabrous, without median carina; forewing with or without rows of radiating setae; scutellum not or hardly overhanging dorsellum. *Female*: gaster with last tergum longer than preceding tergum and covering most of elongate ovipositor sheaths (Figs. 212, 213). *Male*: funicular segments nodose with whorls of long setae (Figs. 216, 217) 45

45(44) *Female*: Gt_1 with 2 or 3 dorsal carinae. *Male*: Gt_1 with 1 dorsal carina (e.g., Figs. 212, 214). *Both sexes*: forewing with 2 rows of setae radiating from stigma; torulus at lower margin of eye; radicle elongate, 0.8 times length of pedicel; mesoscutum reticulate and scutellum either strigose with posteromedial half subglabrous (then head and mesosoma brownish-black) or reticulate with posteromedial half alutaceous (then head and mesosoma yellow) .... ***Allocerastichus*** Masi

Key: Coote (1994). **Fauna**: 2 spp. in USA (MD, MS, NC, VA, SC). **Hosts**: unknown, but extralimital spp. on Ciidae.

– *Both sexes*: Gt_1 without carinae (Fig. 213); forewing without rows of setae radiating from stigma; torulus distinctly below lower margin of eye; radicle short, 0.4–0.5 times length of pedicel; mesoscutum and scutellum uniformly reticulate to glabrous; head and mesosoma brownish-black .... ***Carlyleia*** Girault
Fauna: 1 sp., *C. marilandica* Girault, in USA (FL, GA, MD, MO) (see Coote 1994).

46(5, 7) Wings absent or greatly shortened, not extending more than half length of gaster (Figs. 20, 22) 47
– Wings present and extending more than half length of gaster 52

47(46) *Male only*: malar sulcus absent (Fig. 7); eye slightly to considerably reduced (Figs. 4, 7, 11); scape (Figs. 4, 11) slightly to considerably swollen. [**Note**: males of *Kocourekia* are unknown but may key here.] 48
Male or *female*: malar sulcus present (as in Figs. 107, 114, 120); eye normal; scape variable 49

48(47) Frontofacial sutures absent (Fig. 4); head somewhat enlarged .... ***Melittobia*** Westwood, see 56
– Frontofacial sutures present and widely separated from each other dorsally (Fig. 11); head not enlarged .... ***Tachinobia*** Bouček, see 56

49(47) Midlobe of mesoscutum with only 1 row of adnotaular setae at lateral margin (Fig. 85) 50
– Midlobe of mesoscutum **either** with setae uniformly (although sparsely) covering mesoscutum (Fig. 20) **or** with setae in 2 or more rows at lateral margin (Fig. 22) 51

50(49) Dorsellum divided medially by longitudinal channel (Fig. 86); scutellum without submedian grooves, with deep sublateral grooves (Fig. 86); midlobe of mesoscutum without median groove (Fig. 85); callus with many (more than 10) setae (Fig. 86); vertex with small but distinct transverse carina posterior to ocelli (Fig. 88). *Female*: flagellum with third anellus larger than preceding 2 anelli and with setae (Fig. 87) .... ***Tetrastichomyia*** Girault, see 96

– Dorsellum not divided medially (as in Figs. 90, 98, 118); submedian grooves on scutellum and median line on midlobe of mesoscutum variable, but usually present; callus usually with less than 10 setae; vertex usually without transverse carina. *Female*: flagellum with third anellus about equal in size to preceding anelli, but if somewhat larger than preceding two then third anellus not setose. [**Note**: a few aberrant species of *Aprostocetus* might key through here.] 103

51(49) Midlobe of mesoscutum sparsely but uniformly covered with setae (Fig. 20). *Female*: clava with long terminal spine (as long as apical claval segment) .... ***Exalarius*** LaSalle

Fauna: 1 sp., *E. huachucensis* LaSalle (1994), in USA (AZ).

– Midlobe of mesoscutum bare medially, but with setae in 2 or more sparse rows at lateral margin (Fig. 22). *Female*: clava without such a long terminal spine .... ***Apterastichus*** LaSalle

Fauna: 1 sp., *A. oculatus* LaSalle (1994), in USA (FL).

52(46) Malar sulcus absent (Figs. 5, 8, 12); body usually somewhat flattened, with elongate pronotum (Figs. 1, 6, 14, 19); midlobe of mesoscutum without median line (Figs. 1, 6, 10, 14, 19); submarginal vein with 3–6 dorsal setae (Figs. 134, 135). *Female*: hypopygium extending beyond (generally well beyond) middle of gaster (Fig. 15); funicle with segments generally wider than long to quadrate (Fig. 152) 53

– Malar sulcus present (Figs. 23, 107, 114, 120); other features variable, present or absent, but usually not present in above combination 58

53(52) Protibia enlarged, with large, black, cleft apical spur (Fig. 18); pronotum large and rectangular (Fig. 19); head distinctly wider than high and frontofacial sutures widely separated dorsally, the sutures enclosing a small triangular area below anterior ocellus (Fig. 17). *Female*: ovipositor distinctly exserted (Fig. 16) .... ***Crataepus*** Förster

Fauna: 1 Holarctic sp., *C. marbis* (Walker), in Canada (MB, ON). **Hosts**: Tephritidae in flower heads of thistles (*Carduus*, *Cirsium*) .

– Protibia normal, without enlarged apical spur; other features variable, but not in above combination 54

54(53) Scutellum and mesoscutum with numerous scattered setae (Figs. 1, 2); frontofacial sutures narrowly separated from each other dorsally (as in Fig. 3); head densely setose .... ***Kocourekia*** Bouček

Fauna: 1 Holarctic sp., *K. debilis* (Ratzeburg), in USA (NC). **Hosts**: associated with galls of Cynipidae, possibly a parasite of a small sphecid (Sphecidae s.l.).

– Scutellum with only 2 pairs of setae (rarely with an extra 1 or 2 setae) and mesoscutum with or without many scattered setae; other features variable 55

55(54) Midlobe of mesoscutum with setae scattered over entire surface, not restricted to a single row at lateral margin (Figs. 6, 10) 56

– Midlobe of mesoscutum with setae restricted to 1 row of adnotaular setae at lateral margin (Fig. 14) 57

56(55) Frontofacial sutures widely separated from each other dorsally (Fig. 9); scutellum without submedian grooves (Fig. 10); head and mesosoma with setae generally erect .... ***Tachinobia*** Bouček (part)

Key: Bouček (1977). **Fauna**: 1 sp., *T. repanda* Bouček, in USA (FL). **Hosts**: gregarious parasite of Diptera, particularly Tachinidae parasitizing Lepidoptera.

– Frontofacial sutures narrowly separated from each other dorsally (Fig. 3); scutellum with distinct submedian grooves (Fig. 6); head and mesosoma with setae generally decumbent .... ***Melittobia*** Westwood (part)

Key: Dahms (1984*a*). **Fauna**: 8 spp. (see LaSalle 1994). **Hosts**: mainly parasites (often gregarious) of Aculeata, but parasitizes a wide variety of hosts; see Dahms (1984*b*) for biology.

57(55) Frontofacial sutures widely separated from each other dorsally (Fig. 13); scutellum with distinct submedian grooves (Fig. 14) .. .. ***Pronotalia*** Gradwell (part)

Fauna: 1 sp., *P. carlinarum* (Szelényi & Erdös) (also known from Europe). **Hosts**: gregarious parasites in Diptera puparia, mainly Tephritidae, but also Chloropidae and Agromyzidae. (Key to European species: Graham 1991.)

– Frontofacial sutures narrowly separated from each other dorsally (Fig. 91); scutellum without or with only indistinct submedian grooves, but with deep sublateral grooves (Fig. 94) .... ***Aceratoneuromyia*** Girault, see 99

58(52) Scape and pedicel with distinct, raised, rasp-like sculpture on inner surface (Fig. 24); postmarginal vein about half as long as stigmal vein (Fig. 136); gena distinctly swollen posterior to curved malar sulcus (Fig. 23). *Female*: flagellum with 4 large anelli having combined length equal to that of first funicular segment (Fig. 24) .... ***Quadrastichodella*** Girault

Fauna: 1 sp., *Q. nova* Girault, introduced from Australia into USA (CA). **Hosts**: phytophagous, associated with seed pods of *Eucalyptus* (Myrtaceae). (See Boucek 1977, 1988.)

– Scape and pedicel without rasp-like sculpture; other features variable, but female without such large anelli 59

59(58) Propodeum (at least callus and area just medial to spiracle) densely covered with fine setae (Figs. 25, 26); mesoscutum without median line, densely and uniformly covered with short, fine setae (Fig. 25); forewing (Fig. 137) densely setose basally, without speculum; postmarginal vein present and 0.5–1.0 times length of stigmal vein .... ***Eriastichus*** LaSalle

Key: LaSalle (1994). **Fauna**: 1 sp., *E. cigdemae* LaSalle, in USA (TX), also in Mexico and Costa Rica.

– Propodeum never so densely setose; callus never with more than 10–15 setae; other features variable 60

60(59) Head with postgenal sulcus and with strongly swollen gena; vertex extending much higher than dorsal margin of eye (Fig. 27); propodeal spiracle small, round, and near or behind midline of propodeum, the spiracle separated by distinctly more than its own diameter from anterior margin (Fig. 28); submarginal vein with (usually 3) short setae on dorsal surface, these in distinct contrast to the very long setae on marginal vein (Fig. 138); entire body extremely elongate (Fig. 28) .... ***Henryana*** Yoshimoto

Fauna: 1 sp., *H. magnifica* Yoshimoto, in USA (FL, GA, MO, VA) to as far south as Brazil, and at least 1 undescribed sp. in southeastern USA.

– Head without postgenal sulcus and with gena swollen or not; propodeal spiracle usually larger and within its own diameter of anterior margin of propodeum; submarginal vein with setae not contrasting so distinctly in size with setae of marginal vein; body not so elongate 61

61(60) Postmarginal vein present and distinctly longer than half length of stigmal vein (Figs. 139, 140) 62

– Postmarginal vein absent or, if present, no more than half length of stigmal vein (Figs. 141–151) 66

62(61) Torulus relatively high on head, distinctly above lower margin of eye and about halfway between anterior ocellus and clypeal margin (Fig. 34); apex of scape extending distinctly above level of vertex; vertex with deep suture enclosing ocellar triangle and extending to margin of eye (Fig. 33) (suture often difficult to see because head often collapsed when dry) .... ***Oncastichus*** LaSalle

Fauna: 1 sp., *O. goughi* Headrick & LaSalle, accidentally introduced from Australia into USA (CA). **Hosts**: gall former on *Chamelaucium uncinatum* (Myrtaceae). (See Headrick et al. 1995.)

– Torulus lower on head, with apex of scape not extending distinctly above level of vertex; vertex without such a deep suture enclosing ocellar triangle (at most as in Fig. 103) 63

63(62) Midlobe of mesoscutum with only 1 row of adnotaular setae; scutellum without sublateral grooves and with anterior pair of setae in anterior half, the setae distinctly closer to anterior margin than to posterior pair (Fig. 32) .... ***Peckelachertus*** Yoshimoto

Fauna: 1 sp., *P. diprioni* Yoshimoto, in Canada (PQ) (also Europe, see Graham 1991). **Hosts**: eggs of Diprionidae.

– Midlobe of mesoscutum **either** with 2 or 3 rows of adnotaular setae (Fig. 29) **or** with setae uniformly scattered over entire surface (Figs. 35, 37); scutellum variable 64

64(63) Scutellum with more than 3 pairs of setae and with distinct submedian grooves (Fig. 30); midlobe of mesoscutum with 2 or 3 rows of adnotaular setae, but with median bare area (Fig. 29); toruli widely separated, the distance between them slightly greater than distance from torulus to eye margin (Fig. 31)................................ .... ***Mesofrons*** LaSalle

Fauna: 1 sp., *M. villosus* LaSalle (1994), in USA (OR).

– Scutellum with only 2 pairs of setae and without submedian grooves (Figs. 36, 38); midlobe of mesoscutum with setae uniformly scattered over entire surface (Figs. 35, 37); toruli closer together, the distance between them less than distance from torulus to eye margin 65

65(64) Scutellum (Figs. 35, 36) with anterior pair of setae in anterior half, distinctly closer to anterior margin of scutellum than to posterior pair of setae; propodeum with spiracle in shallow furrow formed between paraspiracular carina and a second carina lateral to spiracle, and hind corner of propodeum with small but distinct, posteriorly directed spine (Fig. 36) .... ***Cucarastichus*** LaSalle

Fauna: 1 sp., *C. texanus* LaSalle (1994), in USA (TX). **Hosts**: hyperparasite of oothecae of *Supella longipalpa* (Fabricius) (Blatellidae) through *Anastatus tenuipes* Bolívar y Pieltain (Eupelmidae).

– Scutellum (Figs. 37, 38) with both pairs of setae in posterior half and distinctly closer to each other than to anterior margin of scutellum; propodeum without spiracle in shallow furrow as described above, and hind corner without spine (Fig. 38) .... ***Careostrix*** LaSalle

Fauna: 1 sp., *C. yoshimotoi* LaSalle (1994), in USA (FL, MI).

66(61) Submarginal vein with 1 seta on dorsal surface (Figs. 141, 142) 67

– Submarginal vein with 2 or more setae on dorsal surface (Figs. 143, 145–151) 75

67(66) Dorsum of mesosoma with very strong, black setae (Figs. 41, 42); upper face with numerous short, stout, black setae (the setae appearing white in photomicrograph) (Fig. 39); foreleg with basitarsus very short, distinctly shorter than second tarsal segment (Fig. 42), and with last tarsal segment about as long as segments 1–3 combined; scutellum without submedian grooves (Fig. 41); mandible characteristically shaped, with large falcate outer tooth and 2 very small, closely approximated inner teeth (Fig. 40) .... ***Chytrolestes*** LaSalle

Fauna: 1 sp., *C. alibaba* LaSalle (1994), in Canada (PQ) and USA (KS). **Hosts**: *Phanagenia bombycina* (Cresson) (Pompilidae).

– Dorsum of mesosoma and upper face without such characteristic black setae; tarsi never as above; other features variable 68

68(67) Mandible characteristically shaped, with large falcate outer tooth and 2 very small, closely approximated inner teeth (as in Fig. 40); Gt_1 dorsally with sculpture (Figs. 43, 44); mesosoma dorsally brightly metallic, with erect, silvery setae; scutellum with at least 3 pairs of setae (Fig. 44) .... ***Chaenotetrastichus*** Graham

Fauna: 1 sp., *C. semiflavus* (Girault), in USA (TX). **Hosts**: *Auplopus* (Pompilidae). (See Graham (1987) for discussion of the single European species.)

– Mandible not as above; Gt_1 dorsally not sculptured; mesosoma dorsally without erect, silvery setae; scutellum usually with only 2 pairs of setae, rarely with 3 69

69(68) Propodeum with inverted Y-shaped paraspiracular carina just medial to spiracle (Fig. 47) .... ***Tetrastichus*** Haliday

Fauna: 21 spp., widespread. **Hosts**: varied, including Coleoptera, Hymenoptera, Diptera, and Lepidoptera. (Key to European species: Graham 1991.)

– Propodeum without inverted Y-shaped carina medial to spiracle (Fig. 46), sometimes with simple paraspiracular carina (as in Fig. 53), the carina without a distinct branch directed posteromedially and therefore without a characteristic Y-shape 70

70(69) Combination of features as follows: body dorsoventrally flattened, with relatively long pronotum and propodeum (Fig. 45); propodeal spiracle small, circular, and separated from anterior margin of propodeum by more than its own diameter (Fig. 46); clava with long, narrow terminal spine, and terminal spine with apical seta as long as itself (similar to that seen in *Aceratoneuromyia*, Fig. 92) .... ***Kostjukovius*** Graham

Fauna: 1 sp., *K. grahami* LaSalle, in USA (AR, GA, ID). **Hosts**: unknown, but the single European species on Chloropidae (Graham, 1991).

– Combination of features differing somehow from above: body only rarely flattened and then **either** propodeal spiracle larger and placed within its own diameter of the anterior margin **or** clava not as above 71

71(70) Midlobe of mesoscutum with 2 adnotaular setae, one in anterior half of mesoscutum and the other in posterior half, these setae relatively strong, dark, subequal in length, and erect or semi-erect (Fig. 49); clypeus with anterior margin truncate, without teeth (Fig. 48) or (rarely) with 2 very small lobes; body never with metallic color, the mesosoma black and gaster black or black with yellow markings. *Male*: genitalia distinctive, the digitus 4–6 times as long as broad and with curved apical spine continuous with outer edge, and aedeagus elongate and often exserted (Fig. 50) .... ***Tamarixia*** Mercet

Fauna: 3 spp., widespread. **Hosts**: Psylloidea. (Key to European species: Graham 1991.)

– Midlobe of mesoscutum with 1 to several adnotaular setae, these setae differing in general appearance from those described above, but if with 2 setae then clypeal margin distinctly bidentate (Fig. 51) and body usually with some metallic color; other features variable. *Male*: without such distinctive and elongate genitalia 72

72(71) Combination of features as follows: funicle with all segments longer than broad (as in Fig. 155); mesosoma with distinct metallic color; mesoscutum with at least 2 adnotaular setae and without median line (Fig. 116). [**Note**: some aberrant forms of subgenus *Ootetrastichus* with only 1 seta on the submarginal vein key here.] .... ***Aprostocetus*** (***Ootetrastichus*** Perkins), see 102

– Combination of features differing somehow from above: if all funicular segments longer than broad then **either** mesosoma without metallic color, **or** mesoscutum with only 1 adnotaular seta (Fig. 52), **or** mesoscutum with median line (Fig. 52) 73

73(72) *Male only*: scutellum without submedian or sublateral grooves and with anterior pair of setae in anterior half (Fig. 57); mesoscutum without median line (Fig. 57); scape without ventral sensory plaque; at least metacoxa white in contrast to dark brown mesosoma. [**Note**: some males of *P. xylebori* with only 1 dorsal setae on the submarginal vein key here.] .... ***Phymastichus*** LaSalle, see 76

– *Female* or, *if male*, differing somehow from above: **either** scutellum with distinct submedian and sublateral grooves (Figs. 53, 55), **or** mesoscutum with median line (Fig. 52), **or** scape with a distinct ventral sensory plaque, **or** color different 74

74(73) Funicle with all segments longer than broad (Fig. 154) and with at least third segment (and sometimes the others) having long, curved, longitudinal sensilla extending beyond apex of segment; mesoscutum often with only 1 adnotaular seta (Fig. 52), though sometimes with 2–4 setae. *Female*: gaster usually elongate and usually with apex acute (Fig. 54) .... ***Quadrastichus*** Girault

Fauna: 10 spp., widespread. **Hosts**: mainly Cecidomyiidae or Coleoptera, but also recorded from Cynipidae, Tephritidae, and gall-forming mites (Eriophyidae). (Key to European species: Graham 1991.)

– Funicle with at least third segment, and often the others, quadrate or wider than long (Fig. 153) and segments without such long, curved, longitudinal sensilla; mesoscutum with 2 or more adnotaular setae (Fig. 55). *Female*: gaster usually shorter and more ovate (Fig. 56) .... ***Oomyzus*** Rondani

Fauna: 5 spp., widespread. **Hosts**: mainly Coleoptera, but also Lepidoptera, Neuroptera, and Diptera. (Key to European species: Graham 1991.)

75(66) Forewing infuscate beyond parastigma except for hyaline stripe near apex of stigmal vein (Fig. 145); parastigma swollen and darker than remaining wing veins; petiole present, short, white to yellow, and distinctly contrasting with dark brown propodeum and gaster; all coxae white to yellow and somewhat elongate .... ***Paraspalangia*** Ashmead

Fauna: 1 sp., *P. annulipes* Ashmead, in USA (CA, TX).

– Forewing hyaline or only very slightly and uniformly infuscate (Figs. 146–151); parastigma rarely swollen (and then wing hyaline); petiole present or absent, but if present then not contrasting in color with propodeum and gaster; coxae variable 76

76(75) Forewing with parastigma at least slightly swollen, particularly along anterior margin of wing (Fig. 143); scutellum without submedian or sublateral grooves and with anterior pair of setae closer to anterior margin of scutellum than to posterior pair of setae (Fig. 57); at least metacoxa white to yellow in distinct contrast to dark brown mesosoma. *Female*: gaster with last tergum in dorsal view having strong, step-like carina encompassing cerci, with many strong setae between the cerci, and with peculiar scale-like sculpture anterior to the carina on medial part of tergum (Fig. 59); ovipositor sheaths, when visible, strong and flattened, blade-like (Fig. 58). *Male*: scape without ventral sensory plaque .... ***Phymastichus*** LaSalle (part)

Note: the features of the last tergum, ovipositor, and color of the metacoxa are not found in the only other species of this genus, *P. coffea* LaSalle, described from Africa but recently imported into Mexico and Central America for biological control of coffee berry borer, *Hypothenemus hampei* (Ferrari) (Scolytidae).

Fauna: 1 sp., *P. xylebori* LaSalle (1995), in USA (NC) (also in Hawaii, Costa Rica).

– Forewing with parastigma not swollen; scutellum usually with submedian or sublateral grooves, rarely without grooves; coxae with color usually different from above. *Female*: gaster with last tergum and ovipositor never as above. *Male*: scape with ventral sensory plaque 77

77(76) Lower face with conspicuous striae radiating from mouth margin (Fig. 62); hind wing with apex of vein (at hamuli) swollen or knobbed (Fig. 144); petiole present and distinct (Fig. 63).......... .... ***Ceratoneura*** Ashmead

Fauna: 2 spp., *C. petiolata* Ashmead and *C. pretiosa* Gahan, in USA (AZ, FL, TX). **Hosts**: associated with galls (perhaps always of Cecidomyiidae) on a variety of plants.

– Lower face without radiating striae; hind wing with apex of vein not swollen or knobbed; petiole usually absent, rarely present 78

78(77) Gt_1 (or Gt_1 and short Gt_2) smooth dorsally in distinct contrast to remaining, reticulate terga (Fig. 60); propodeum fairly long, with strong, straight carina extending directly from spiracle to posterior margin and with median area strongly and uniformly reticulate (Fig. 61); petiole distinct, but short; midlobe of mesoscutum with 1 row of adnotaular setae; body strongly sclerotized .... ***Paragaleopsomyia*** Girault

Fauna: 3 spp.; genus New World only, mainly Neotropical. **Hosts**: associated with galls of Cecidomyiidae.

– Gaster never as above, occasionally strongly reticulate dorsally, but then Gt_1 not smooth; propodeum usually not so distinctly reticulate, but if so then paraspiracular carina medial to spiracle rather than extending directly backwards from it (Figs. 79, 84) and mesoscutum often with more than 1 row of adnotaular setae (Figs. 78, 83) 79

79(78) Petiole present and distinct, at least half as long as wide and dorsally with distinct sculpture (Fig. 69), **and** torulus high on face, the scape thus extending well above level of vertex (Figs. 66, 67) 80

– Petiole absent or hidden, less than half as long as wide and dorsally without sculpture or, if sculpture present (rarely), torulus near or below middle of face, the scape thus not exceeding level of vertex 81

80(79) Axilla not or barely projecting anterior to scutoscutellar suture, the scapular flange broad and triangular (Fig. 64); propodeum with complete, strong and raised median carina, with strong arc-shaped paraspiracular carina, and with reticulate to rugose median panels (Fig. 65); dorsellum entire (Fig. 65); face strongly sculptured, with many scattered setiferous punctures (Fig. 66) .... ***Oxypracetus*** LaSalle

Fauna: 1 sp., *O. opacus* LaSalle (1994), in USA (MN, OH, VT).

– Axilla projecting distinctly anterior to scutoscutellar suture, the scapular flange linear (Fig. 68); propodeum rugose, without complete median carina, without distinct paraspiracular carina, and with strong, irregular carinae on median panels (Fig. 69); dorsellum divided medially by longitudinal groove or series of deep punctures (Fig. 69); face smooth or lightly sculptured, with at most minute punctures (Fig. 67) .... ***Lisseurytomella*** Gahan & Fagan

Fauna: 1 sp., *L. flava* (Ashmead), in USA (FL, TX), and extending to northern South America. **Hosts**: phytophagous in seeds of *Cardiospermum* (Sapindaceae).

81(79) Mesosoma dorsally with unusually strong setae (Figs. 70, 71, 72), at least the anterior pair of scutellar setae (Figs. 70, 71, 73) and usually also the setae on mesoscutum and pronotum; mesoscutum with median line and scutellum with submedian grooves wide and shallow (Figs. 70, 72, 73) 82

– Mesosoma dorsally with setae not distinctly stronger than normal; mesoscutum and scutellum with grooves variable 83

82(81) Scutellum with anterior pair of setae much stronger than posterior pair, the latter of normal size (Fig. 73); submarginal vein with 3 or more setae. *Female*: antenna with short clava having long terminal spine as long as apical claval segment, and with dark flagellum. *Male*: forewing without dark spot on anterior margin beyond stigmal vein 83

– Scutellum **either** with both pairs of setae strong (Figs. 70, 71) **or** with more than 2 pairs of enlarged setae; submarginal vein usually with 2 setae (Fig. 146). *Female*: antenna with clava not having such a long terminal spine and flagellum usually yellow or otherwise light colored. *Male*: forewing often with dark spot on apical margin beyond stigmal vein .... ***Pentastichus*** Ashmead

Fauna: 1 described sp., *P. ithacus* (Moser), in USA (NY, OH, WV), and several undescribed spp.; genus New World only, well represented in more tropical areas (see LaSalle 1994). **Hosts**: associated with galls.

83(81, 82) Scutellum with anterior pair of setae distinctly stronger and longer than posterior pair (Fig. 73); midlobe of mesoscutum with at least a few setae near middle of sclerite in addition to adnotaular setae (Fig. 72), the median setae usually smaller than the adnotaular setae; dorsellum flattened, with posterior margin slightly overhanging propodeum; mesoscutum with median line and scutellum with submedian grooves wide and shallow (Figs. 72, 73). *Female*: clava short, with long terminal spine as long as apical claval segment .... ***Hadrotrichodes*** LaSalle

Fauna: 1 sp., *H. waukheon* LaSalle (1994), in USA (CA), and a possible second species in USA (VA).

– Scutellum with anterior pair of setae not distinctly longer and stronger than posterior pair; other features variable, but not in above combination 84

84(83) Mesoscutum uniformly, densely or sparsely setose (Figs. 74, 75, 76, 78, 127, 132), or with just a small bare area anteromedially (Fig. 125) 85

– Mesoscutum not uniformly setose and with a well-defined bare area medially, usually with 1 row (Figs. 85, 89, 95, 122) or at most with 2 or 3 rows of adnotaular setae (Figs. 83, 97, 109) 92

85(84) Mesosoma metallic blue-green in distinct contrast to gaster, the gaster predominantly yellow although darkened dorsally; scutellum with 3–5 pairs of setae and without submedian grooves (Fig. 74). *Female*: ovipositor with exserted portion at least half as long as metatibia .... ***Dapsilothrix*** LaSalle

Fauna: 1 sp., *D. jeanae* LaSalle (1994), in USA (TX) and Mexico (Baja California Sur).

– Mesosoma and gaster not colored as above, either both metallic or both non-metallic; scutellum with 2 to many pairs of setae and usually with submedian grooves. *Female*: ovipositor with exserted portion variable, but usually less than half as long as metatibia 86

86(85) Scutellum with 4 to many pairs of setae (Figs. 77, 125) 87

– Scutellum usually with 2 pairs of setae (Figs. 75, 79), rarely with a third pair 88

87(86) Scutellum with submedian grooves distinct, about equidistant from each other and from sublateral grooves (Fig. 125); cercus with setae unequal in length, with 1 seta distinctly longer than the others and sinuate (Fig. 126); propodeum with raised lobe of callus partly overhanging outer rim of spiracle (Fig. 125); mesosoma and gaster with distinctive, white to silver setae .... *A*. (***Aprostocetus*** Westwood), see 103

Note: 1 aberrant sp., *A. (A.) homeri* (Girault), in USA (FL, GA, IA, SC, VA).

– Scutellum with submedian grooves faint or absent (Fig. 77), but if indicated then grooves much closer to each other than to sublateral grooves and enclosing area at least 4 times as long as wide; cercus with setae subequal in length and straight; propodeum with entire rim of spiracle visible (Fig. 77); mesosoma and gaster with darker setae .... ***Comastichus*** LaSalle

Fauna: 1 sp., *C. zopheros* LaSalle (1994), in USA (FL) (also Mexico and Costa Rica). **Hosts**: predator in spider (Araneae) egg sacs.

88(86) Combination of features as follows: middle and hind legs with basitarsus distinctly (about 1.5 times) longer than second tarsal segment (Fig. 131); metacoxa yellow; cercus with setae unequal in length, with 1 seta distinctly longer than the others and sinuate (as in Figs. 124, 126); propodeum with raised lobe of callus partly overhanging outer rim of spiracle (Fig. 133); scutellum with both pairs of setae close together near posterior margin of scutellum (Fig. 133); in cockroach oothecae .... ***Aprostocetus*** (***Tetrastichodes*** Ashmead)

Fauna: 1 cosmopolitan sp., *A.* (*T.*) *hagenowii* (Ratzeburg), in USA (AL, FL, GA, LA, MS, SC, TX) [the only other sp., *A.* (*T.*) *asthenogmus* (Waterston), is apparently pantropical and has been recorded from Cuba]. **Hosts**: in oothecae of Blattidae.

– Combination of features somehow differing from above: if middle and hind legs with basitarsus distinctly longer than second tarsal segment then **either** metacoxa dark or metallic, **or** cercus with the longest 2 setae subequal in length and straight or only slightly curved, **or** entire rim of propodeal spiracle visible, **or** scutellum with anterior pair of setae near midline of scutellum, **or** host different 89

89(88) Scutellum strongly sculptured, rugose, with submedian grooves either indistinct or as broad shallow furrows, and with sublateral grooves strong and laterally carinate (Fig. 79); propodeum distinctly reticulate medially, with smooth area between spiracle and strong paraspiracular carina (Fig. 79), and with raised lobe of callus partly overhanging outer rim of spiracle; cercus with setae subequal in length; in spider egg sacs .... ***Aranobroter*** LaSalle

Fauna: 1 undescribed sp. in USA (TX) [see LaSalle (1990) for key to Neotropical species]. **Hosts**: predator in spider (Araneae) egg sacs. (See LaSalle 1990, 1994.)

– Scutellum and propodeum not so strongly sculptured (Fig. 128); other features variable, but never present in above combination 90

90(89) Scutellum without submedian grooves and with anterior pair of setae near anterior margin of scutellum (Fig. 75); mesoscutum sparsely covered with long, erect or semi-erect setae (Fig. 75); cercus with 1 seta distinctly longer than the others and sinuate .... ***Styotrichia*** LaSalle

Fauna: 2 spp., *S. quadrata* LaSalle (1994) and *S. bicolor* LaSalle (1994), in USA (FL, NC).

– Scutellum with submedian grooves (Figs. 127, 128) and anterior pair of setae near or behind midline of scutellum; mesoscutum more densely setose, with short, decumbent setae; cercus with setae often subequal in length 91

91(90) Propodeum with raised lobe of callus partly overhanging spiracle (Fig. 128); mesoscutum completely covered with setae (Fig. 127); cercus with setae variable, either 1 seta distinctly longer than the others and sinuate (Fig. 129) or the longest 2 setae subequal in length, relatively short and often not conspicuously different from the setae on surrounding gastral terga (Fig. 130) .... ***Aprostocetus*** (***Quercastichus*** LaSalle)

Fauna: 5 spp.; genus New World only. **Hosts**: parasites in galls of Cynipidae on *Quercus*. (See LaSalle 1994.)

– Propodeum with entire rim of spiracle visible (Fig. 111); mesoscutum usually with at least anteromedian area bare; cercus with at least the longest 2 setae subequal in length, relatively short and often not conspicuously different from the setae on surrounding gastral terga (Figs. 112, 113) .... ***Baryscapus*** Förster, see 105

Note: hosts extremely varied; some species of *Baryscapus* might occur in galls of Cynipidae.

92(84) Mouth opening large, at least 3 times as long as malar space (Figs. 104, 106); mandible usually enlarged 93

– Mouth opening small, usually less than twice as long as malar space (Figs. 91, 115); mandible usually not enlarged 95

93(92) Mandibles exodont and not meeting medially (Fig. 104) .... ***Exastichus*** LaSalle

Fauna: 1 sp., *E. odontos* LaSalle (1994), in USA (CA).

– Mandibles normal, curving inwards and meeting or overlapping medially 94

94(93) Propodeum with raised lobe of callus partly overhanging spiracle (as in Fig. 123); malar sulcus straight or only slightly curved. *Female*: funicle 4-segmented with first segment smaller than the second .... ***Kocaagizus*** Doğanlar

Fauna: 1 sp., *K. pirireisi* Doğanlar (1993), in USA (NY).

– Propodeum with entire rim of spiracle visible; malar sulcus distinctly curved. *Female*: funicle 3-segmented .... ***Baryscapus*** Förster, see 105

Note: 1 sp. keys here, *B. megos* Surekha & LaSalle, in southwestern USA (AZ) (Surekha and LaSalle, 1996).

95(92) Body strongly sclerotized (Figs. 80–84), with all gastral terga reticulate and non-collapsing (Figs. 81, 82); propodeum strongly reticulate, with strong paraspiracular carina and strong transverse carina along posterior margin (Fig. 84); malar space with distinct fovea just below eye (Fig. 80) .... ***Galeopsomyia*** Girault

Fauna: 5 spp.; genus New World only, strongly represented in Neotropical region. **Hosts**: associated with galls, mostly as parasites of Cecidomyiidae and Cynipidae, although inquilines are known.

– Body not so strongly sclerotized and gastral terga not reticulate; propodeum rarely strongly reticulate, but if so then without carinae as described above; malar space only rarely with fovea 96

96(95) Dorsellum divided medially by longitudinal channel (Fig. 86); scutellum without submedian grooves but with deep sublateral grooves (Fig. 86); midlobe of mesoscutum without median line (Fig. 85); propodeum with callus having many (more than 10) setae (Fig. 86); vertex with small but distinct transverse carina posterior to ocelli (Fig. 88). *Female*: third anellus larger than preceding 2 anelli and with setae (Fig. 85) .... ***Tetrastichomyia*** Girault (part)

Fauna: 3 spp. (see LaSalle and Schauff 1990), one of which is brachypterous (see couplet 50). **Hosts**: only known for the Holarctic *T. clisiocampae* (Ashmead), a parasite (occasionally hyperparasite) of a variety of Lepidoptera.

– Dorsellum not divided medially (Figs. 90, 98, 118); submedian grooves of scutellum and median lines of mesoscutum variable but usually present; callus usually with fewer than 10 setae; vertex usually without transverse carina. *Female*: if third anellus somewhat larger than preceding 2 then without setae 97

97(96) Submarginal vein with 2 dorsal setae fairly close to each other near middle of vein (Fig. 147); gaster distinctly narrowed at base (Fig. 90) and with dorsal, subbasal pale spot; petiole small but visible; propodeum (Fig. 90) large, smooth, without median carina, and with entire rim of spiracle exposed; parasite of thrips. *Female*: ovipositor sheaths short and concealed .... ***Thripastichus*** Graham

Fauna: 1 cosmopolitan sp., *T gentilei* (Del Guercio), introduced into New World. **Hosts**: Phlaeothripidae. (See Graham 1991.)

– Somehow differing from above: submarginal vein usually with 3 or more setae, but if with only 2 setae then **either** gaster not so narrowed, **or** without visible petiole, **or** without dorsal, subbasal pale spot, **or** host different, **or** female with ovipositor sheaths distinct and partly exserted 98

98(97) Combination of features as follows: torulus distinctly below lower margin of eye (Fig. 13); frontofacial sutures widely separated from each other dorsally (Fig. 13); forewing with decolorized area between parastigma and marginal vein (Fig. 135); body black or dark brown, at most with barely perceptible metallic tinge. *Female*: tip of hypopygium extending slightly beyond middle of gaster (Fig. 15) .... ***Pronotalia*** Gradwell, see 57

– Combination of features somehow differing from above: **either** torulus above (Fig. 115) or level with (Fig. 106) lower margin of eye, **or** frontofacial sutures not widely separated from each other dorsally (Figs. 91, 106), **or** forewing without decolorized area between parastigma and marginal vein (Figs. 148, 151), **or** body distinctly metallic, **or** female with tip of hypopygium before middle of gaster 99

99(98) Combination of features as follows: scutellum without submedian grooves or grooves indistinct, but with strong sublateral grooves (Fig. 94); head and mesosoma with sparse, long, erect setae (Figs. 91, 93); mesosoma somewhat flattened, with relatively long pronotum and propodeum (Fig. 93). *Female*: flagellum (Fig. 92) with all funicular segments transverse, with long, erect setae, and with clava having apical seta of long terminal spine about twice as long as spine (the spine often broken); tip of hypopygium extending beyond middle of gaster .... ***Aceratoneuromyia*** Girault (part)

Fauna: 1 sp., *A. fimbriata* Graham, in USA (FL) (also in Europe) [the mainly Old World *A. indica* (Silvestri) has been moved throughout the world, including into Mexico, the Caribbean, and Central America, as a biological control agent of various fruit flies]. **Hosts**: Diptera, mainly Tephritidae, Calliphoridae, Muscidae, and Sarcophagidae. (Key to European species: Graham 1991.)

– Combination of features somehow differing from above: in particular female antenna different, if all funicular segments transverse then segments without long, erect setae, and terminal spine of clava without long apical seta 100

100(99) Forewing with stigmal vein shorter than or as long as parastigma, and marginal vein 7.0–9.5 times as long as stigmal vein (Fig. 148); propodeum with sculpture stronger than that on mesoscutum or scutellum (Figs. 95, 96); axillae not very strongly advanced (Fig. 95); scutellum distinctly longer than wide and with each anterior seta nearer to sublateral groove than to submedian groove (Fig. 96) .... ***Neotrichoporoides*** Girault

Fauna: 1 cosmopolitan sp., *N. viridimaculatus* (Fullaway), in USA (CA, FL); mainly Old World genus, strongly represented in the Old World tropics. **Hosts**: Diptera in stems of grasses. (Key to European species: Graham 1987.)

– Forewing with stigmal vein usually longer than parastigma and marginal vein at most 6.0 times as long as stigmal vein (Figs. 149–151); propodeum with sculpture not distinctly stronger than that on mesoscutum or scutellum (Figs. 97, 111, 116); axilla usually strongly advanced (Figs. 97, 109, 116); scutellum either wider than long or with each anterior seta not nearer to sublateral groove than to submedian groove (Figs. 98, 111, 118) 101

101(100) Metacoxa with carina extending length of dorsal margin (Fig. 102); propodeum with strong, curved paraspiracular carina; propodeum between median and paraspiracular carina uniformly reticulate, the area lateral to paraspiracular carina distinctly smoother (Fig. 101); vertex with ocelli completely enclosed by sutures, with shallow depression lateral to posterior ocellus (Fig. 103); body bright metallic green to blue .... ***Anaprostocetus*** Graham

Fauna: 1 Holarctic sp., *A. acuminatus* (Ratzeburg), in Canada (ON). **Hosts**: *Euura* (Tenthredinidae). (Key to European species: Graham 1987.)

– Metacoxa without carina along dorsal margin; propodeum and vertex variable, but rarely as above; color variable 102

102(101) Combination of features as follows: forewing with subcubital line of setae starting at or nearly at level of basal setal line (Fig. 149); cercus with 1 seta distinctly longer than the others (usually twice as long) and sinuate or curved (Fig. 119); mesoscutum usually without median line (Fig. 116), rarely with line indicated posteriorly; propodeum with spiracle small, circular, and with or without raised lobe of callus partly overhanging outer rim of spiracle (Figs. 117, 118); gena often somewhat swollen behind malar sulcus (Fig. 114); body generally somewhat elongate and with bright metallic mesosoma ....
.... ***Aprostocetus*** (***Ootetrastichus*** Perkins) (part)

Fauna: 6 spp. **Hosts**: eggs of Hemiptera, Homoptera, Orthoptera, Odonata, and Coleoptera. (Key to European species: Graham 1987.)

– Combination of features somehow differing from above: forewing with subcubital line of setae usually starting (much) further apically on wing, but if starting near basal setal line then the longest 2 cercal setae subequal in length; other features variable 103

103(50, 102) With following three features in combination: submarginal vein with 3 or more dorsal setae (Fig. 150); cercus with 1 seta distinctly (usually 1.5 times) longer than the others and sinuate or curved (Figs. 124, 126); and propodeum with raised lobe of callus partly overhanging outer rim of conspicuous spiracle (Figs. 123, 125). [Mesothoracic venter in lateral view generally flat in front of mesocoxa and with distinct transepisternal sulcus (Fig. 121); malar sulcus usually straight or only slightly curved (Fig. 120).] .... ***A.*** (***Aprostocetus*** Westwood) (part)

Fauna: 58 spp. **Hosts**: extremely varied, but frequently associated with galls. (Key to European species: Graham 1991.)

– With at least one of the three features different: **either** submarginal vein with only 2 setae, **or** cercus with at least the 2 longer setae subequal in length and usually straight or only slightly curved (Figs. 100, 112, 113), **or** propodeum with entire rim of sometimes minute spiracle exposed (Figs. 98, 111) 104

104(102) Combination of features as follows: propodeum with spiracle small, with entire rim exposed and separated from anterior margin by at least half diameter of spiracle (Fig. 98); clypeus with apical margin truncate or weakly bilobed (Fig. 99); cercus with setae subequal in length, straight or only slightly curved (Fig. 100); body metallic with at least some yellow markings .... ***Minotetrastichus*** Kostjukov

Fauna: 1 sp., *M. frontalis* (Nees), in USA (DE, MA, ME, MT, OH); genus mainly Palaearctic. **Hosts**: leaf-mining Lepidoptera, Coleoptera, and Hymenoptera. (Key to European species: Graham 1991.)

– Combination of features somehow differing from above: **either** rim of propodeal spiracle touching or nearly touching anterior margin of propodeum (Figs. 109, 111), **or** propodeum with raised lobe of callus partly overhanging outer rim of spiracle (Fig. 123), **or** clypeus with margin distinctly bidentate (as in Fig. 115), **or** cercus with 1 seta distinctly longer than the others and sinuate (Figs. 124, 126), **or** body entirely metallic or dark, without any yellow markings 105

105(104) Combination of features as follows: cercus with at least longest 2 setae subequal in length, relatively short and often not conspicuously different from the setae on surrounding gastral terga (Figs. 112, 113); propodeal spiracle with entire rim exposed (Fig. 111); and body dark or metallic, without pale or yellow markings. [Mesoscutum often with more than 1 row of adnotaular setae (Fig. 109); mesothoracic venter in lateral view usually convex in front of mesocoxa and without distinct transepisternal sulcus (Fig. 108); malar sulcus often strongly curved (Fig. 107).] .... ***Baryscapus*** Förster (part)

Fauna: 43 spp.; genus mainly Holarctic. **Hosts**: parasites or often hyperparasites of a wide range of hosts.

– Combination of features somehow differing from above: **either** cercus with 1 seta distinctly longer than the others and sinuate (Figs. 124, 126), **or** propodeum with raised lobe of callus partly overhanging outer rim of spiracle (Fig. 123), **or** body with some yellow markings .... ***A. (Aprostocetus*** Westwood), see 103

106(1, 3) Midlobe of mesoscutum covered with numerous unpaired setae (Fig. 274); scutellum with at least 3 pairs of setae and usually with many unpaired setae; submarginal vein dorsally with more than 2 setae 107

– Midlobe of mesoscutum usually with 2 to a few pairs of setae (Figs. 237, 249); scutellum with 1 or, rarely, 2 pairs of setae; submarginal vein dorsally with 2 setae 108

107(106) *Female*: flagellum with first and second funicular segments subequal in length and wider than long (Fig. 294); ovipositor sheaths not widened or flattened; hypopygium extending distinctly more than one-quarter length of gaster. *Both sexes*: eye with numerous small setae .... ***Aleuroctonus*** LaSalle & Schauff

Fauna: 1 sp., *A. vittatus* (Dozier), in USA (FL) and Caribbean. **Hosts**: Aleyrodidae. (See LaSalle and Schauff 1994.)

– *Female*: flagellum with second funicular segment either quadrate or longer than wide and distinctly longer than first funicular segment (Figs. 297, 298); outer plates of ovipositor widened or flattened, visible in ventral view as wide plates (Fig. 275); hypopygium extending distinctly less than one-quarter length of gaster. *Both sexes*: eye bare .... ***Entedononecremnus*** Girault

Fauna: 1 sp., *E. krauteri* Zolnerowich & Rose (1996), in USA (CA, TX) and several undescribed species in Mexico and the Caribbean. **Hosts**: Aleyrodidae. (See also LaSalle and Schauff 1994.)

108(107) Mesosoma dorsally flattened, with large axillae almost entirely forward of scutoscutellar sutures (Fig. 276), the axillae sometimes at least partly fused to mesoscutum so sometimes apparently absent (Fig. 278); flagellum with 1 or 2 funicular segments and clava longer than funicle (Figs. 295, 296); pronotum and dorsellum in dorsal view not or barely visible; body usually shorter than 1 mm and without metallic color; parasites of Aleyrodidae 109

– Mesosoma dorsally at least slightly convex, with axillae not so large and usually with anterior margin in line with or only slightly forward of scutoscutellar sutures and not fused with mesoscutum (Fig. 237); flagellum with 2–4 funicular segments and clava shorter than funicle (Figs. 289–292); pronotum and/or dorsellum in dorsal view usually visible; body usually longer than 1 mm and often with metallic color; parasites of insects other than Aleyrodidae 110

109(108) Axilla about as long as wide and clearly separated from mesoscutum by complete suture (Fig. 276); scutellum with 1 distinct pair of setae medially and 1 small pair (often difficult to see) at posterior margin (Fig. 276); malar sulcus incomplete (Fig. 277) .... ***Euderomphale*** Girault

Fauna: 3 described and several undescribed spp. **Hosts**: Aleyrodidae. (See LaSalle and Schauff 1994.)

– Axilla at least partly fused to mesoscutum (Fig. 278), the suture either absent or visible only at anterolateral corner of axilla; scutellum with only 1 pair of setae; malar sulcus complete (Fig. 279) .... ***Neopomphale*** LaSalle & Schauff

Fauna: 1 described sp., *N. aleurothrixi* (Dozier), and several undescribed spp., in USA (AZ, CA, FL) and the Caribbean. **Hosts**: Aleyrodidae. (See LaSalle and Schauff 1994.)

110(106) Propodeum medially usually with smooth raised area often bordered laterally by depressed area (Figs. 220, 226), but if median area evenly sculptured or smooth then propodeum with nucha projecting posteriorly over metacoxae (Fig. 228) **or** surface of propodeum with several scattered pairs of setae (Fig. 221); stigmal vein short, without distinct 'petiole' (Fig. 286) 111

– Propodeum medially without smooth area bordered laterally by depressed areas (Figs. 224, 225, 230, 231) or, if sculptured medially, propodeum not projecting posteriorly; propodeum with setae restricted to callus; stigmal vein longer, the stigma usually separated from margin of wing by distinct 'petiole' (Figs. 280, 287) 114

111(110) Prepectus with posterior margin interrupted by projecting anterior margin of mesepisternum (Figs. 246, 247); propodeum with anteromedian margin projecting as small tooth up and over posterior margin of metanotum (Figs. 226, 248); axilla at least partly separated from scutellum by distinct sulcus (Fig. 249) 112

– Prepectus with posterior margin entire, not interrupted by mesepisternum (Fig. 250); propodeum with anteromedian margin not extending as tooth over posterior margin of metanotum (Fig. 228); axilla not separated from scutellum by sulcus .... ***Paracrias*** Ashmead

Key: Schauff (1984). **Fauna**: 2 spp. **Hosts**: Curculionidae and Bruchidae.

112(111) Scutellum with at least partial median longitudinal groove (Fig. 249); propodeum with lateral plica and with setae restricted to callus (Figs. 220, 226); head without longitudinal carina along outer margin of eye 113

– Scutellum without median longitudinal groove (Fig. 237); propodeum without lateral plica and with several scattered setae medially (Fig. 221); head with longitudinal carina along outer margin of eye (Fig. 238) .... ***Alachua*** Schauff & Bouček

Fauna: 1 sp., *A. floridensis* Schauff & Bouček (1987), in USA (FL). **Hosts**: pupae of Formicidae.

113(112) Scutellum usually with median longitudinal groove extending at least half length of scutellum (Fig. 249); head with eyes not converging ventrally and torulus more than its own diameter from eye margin (Fig. 243); mesepisternum anteriorly without epicnemial carina; petiole reticulate .... ***Horismenus*** Walker

Key: Burks (1971). **Fauna**: 16 spp. **Hosts**: mainly parasites of Coleoptera, but also of Diptera and Lepidoptera; some species are hyperparasites through other Hymenoptera.

– Scutellum with median longitudinal groove extending less than half length of scutellum, the groove sometimes broken into linear foveae (Fig. 239); head with eyes converging ventrally and torulus less than its own diameter from eye margin (Fig. 241); mesepisternum anteriorly with epicnemial carina (Fig. 240); petiole longitudinally striate (Fig. 226) .... ***Edovum*** Grissell

Fauna/Hosts: 1 sp., *E. puttleri* Grissell (1981), introduced from South America for augmentative biological control of the Colorado potato beetle, *Leptinotarsa decemlineata* (Say) (Chrysomelidae), but does not overwinter in region.

114(110) Notauli complete and deep throughout (Fig. 288); mesoscutum with anterior margin overhanging posterior margin of greatly reduced pronotum, the pronotum not visible dorsally .... ***Eprhopalotus*** Girault

Fauna: at least 1 described sp., *E. purpureithorax* Girault, and 1 undescribed sp., in USA (TX) (see Schauff and LaSalle 1993). **Hosts**: associated with galls on *Quercus*.

– Notauli incomplete, not reaching posterior margin of mesoscutum (Figs. 259, 262, 268); mesoscutum with anterior margin not overhanging posterior margin of pronotum, even though pronotum sometimes reduced 115

115(114) Head with ocellar area clearly encircled by suture (Figs. 263, 266); occipital carina absent medially (Fig. 265); temple with longitudinal carina and modified setae, in dorsal view temple appearing very densely setose; flagellum with 4 funicular segments (third anellus enlarged) and 2 claval segments (Fig. 291) .... ***Derostenus*** Westwood

Key: Hansson (1986). **Fauna**: 3 spp. (see Hansson 1995*a*). **Hosts**: larvae of Lepidoptera.

– Head with ocellar area not outlined by suture (Figs. 253, 260); occipital carina either complete or entirely absent; temple without longitudinal carina or modified setae, in dorsal view temple not appearing densely setose; flagellum appearing to have 2 (or 3) funicular segments and 3 (or 2) claval segments (total number of segments never more than 5) 116

116(115) Propodeum with complete, distinct median or submedian carinae, and often with plicae (Figs. 223, 227, 229) 117

– Propodeum without complete, distinct median or submedian carinae, and rarely with plicae (Figs. 230–233) 120

117(116) Face smooth and frontofacial sutures appearing as distinct transverse sulci (Fig. 252); propodeum with diverging (nearly semicircular) submedian carinae (Fig. 227). *Female*: flagellum with 5 funicular segments, and without evident clava (Fig. 292) .... ***Emersonella*** Girault

Fauna: 2 spp. **Hosts**: eggs of Chrysomelidae.

– Face with at least some areas alutaceous or reticulate, or frontofacial sutures appearing only as depressed areas, not linear (Fig. 253); propodeum either with single median carina (Fig. 223) or with paired submedian carinae that are straight anteriorly (Fig. 222). *Female*: flagellum with 3 funicular segments and 2 claval segments 118

118(117) Propodeum medially with carinae raised anteriorly and forming cup-like expansion (Figs. 229, 244), and with anterior margin having lateral ∨-shaped indentations .... ***Mestocharis*** Förster

Key: Hansson (1988*a*). **Fauna**: 2 spp. **Hosts**: eggs of Dytiscidae.

– Propodeum medially either with single, simple carina or with parallel submedian carinae not forming raised cup-like expansion (Figs. 222, 223), and with anterior margin not having ∨-shaped indentations 119

119(118) Propodeum medially with 2 subparallel carinae diverging posteriorly (Fig. 222) (occasionally beginning as single carina and then diverging) and with distinct plicae; frontofacial sutures distinct; petiole, in most species, with ventrally pointed extension (Fig. 254) .... ***Pediobius*** Walker

Key: Peck (1985). **Fauna**: 32 spp., common and widespread. **Hosts**: Lepidoptera, Coleoptera, Diptera, and Hymenoptera; some species also attack spider eggs (Araneae), often as secondary parasites.

– Propodeum medially with single carina (Fig. 223) in groove or depression and laterally without plicae; frontofacial sutures usually absent, but if present then sutures very fine and difficult to see (Fig. 260); petiole without ventrally pointed extension .... ***Entedon*** Dalman

Key: Schauff (1988). **Fauna**: 18 spp. **Hosts**: Curculionidae, Bruchidae, and other Coleoptera.

120(116) Flagellum with 2 funicular segments and well-defined clava or, if flagellar formula questionable, head with complete vertexal suture (Fig. 255); parasites of Thysanoptera 121

– Flagellum with more than 2 funicular segments or flagellum not clearly separated into funicle and clava, and head never with complete vertexal suture; parasites of insects other than Thysanoptera 125

121(120) Petiole as long as or longer than wide (gaster obviously petiolate) ... . ***Entedonastichus*** Girault

Fauna: 1 sp., *E. kaulbarsi* (Yoshimoto), in Canada (ON, PQ) and USA (FL). **Hosts**: Thysanoptera. (See Yoshimoto 1981, as *Thripoctenoides*.)

– Petiole wider than long (usually barely visible or appearing as small dorsal strip) 122

122(121) Head with transverse vertexal suture; specimen usually smooth or very weakly sculptured and often brown or yellow 123

– Head without transverse vertexal suture (Fig. 255); specimen usually with obvious sculpture at least on mesosoma dorsally and usually metallic green, but rarely black, blue, or yellow 125

123(122) Forewing with posterior margin curved inward, the anterior and posterior margins nearly parallel behind marginal vein; marginal setae longer than width of wing (Fig. 283) ...... ***Goetheana*** Girault

Fauna: 1 introduced sp., *G. parvipennis* (Gahan), released into North America to control the greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouché) (Thripidae).

– Forewing with posterior margin straight, the anterior and posterior margins diverging behind marginal vein; marginal setae shorter than width of wing, usually much shorter (Fig. 282) 124

124(123) Head with malar sulcus straight and simple, and with frontofacial sutures reaching each eye at level of anterior ocellus .... ***Ceranisus*** Walker

Key: Triapitsyn and Headrick (1995). **Fauna**: 5 spp. **Hosts**: larvae of Thripidae and Phlaeothripidae.

– Head with malar sulcus divided ventrally (Fig. 261) and with frontofacial sutures reaching each eye above level of anterior ocellus or intersecting vertexal suture (Fig. 256) .... ***Thripobius*** Ferrière

Fauna: 1 introduced sp., *T. semiluteus* Bouček, released into USA to control the greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouché) (Thripidae).

125(120, 122) Postmarginal vein longer than stigmal vein, usually 1.5–2.0 times as long (Fig. 287); petiole distinct and usually with irregular dorsal sculpture 126

– Postmarginal vein not or only barely longer than stigmal vein; petiole usually not obvious, and not sculptured 127

126(125) *Female*: flagellum usually with 3 funicular segments and distinct clava, and with third anellus enlarged and triangular (usually requires slide-mounted specimen to observe); scape less than 7 times as long as wide .... ***Chrysocharis*** Förster

Key: Hansson (1987, 1995*b*). **Fauna**: 63 spp., common and widespread. **Hosts**: a wide variety of leaf-mining Lepidoptera, Diptera, and Hymenoptera.

– *Female*: flagellum with 5 funicular segments (the clava not obvious), and with only 1, minute, ring-like anellus; scape about 7 times as long as wide .... ***Grahamia*** Erdös

Key: Hansson (1988*a*). **Fauna**: 2 spp. **Hosts**: 1 sp. on *Haplodiplosis equestris* (Wagner) (Cecidomyiidae).

127(125) Forewing with 2 lines of setae radiating from stigmal vein (Fig. 281) 128

– Forewing with at most 1 line of setae radiating from stigmal vein (Figs. 284, 287) 129

128(127) Midlobe of mesoscutum with 1 pair of setae; head without vertical furrow between occiput and foramen magnum .... ***Chrysonotomyia*** Ashmead

Note: until recently *Chrysonotomyia* included most of the species now assigned to *Closterocerus* and *Neochrysocharis*. Hansson (1990, 1994*a*, 1995*a*) altered the concepts of these groups and reassigned most of the species. Although there remains some controversy about the limits of these genera and not all authors follow his classification, we have followed Hansson's classification so that the key presented here reflects the most recent literature.

Fauna: 1 sp., *C. auripunctata* (Ashmead), in USA (FL). **Hosts**: Cecidomyiidae. (See Hansson 1994*b*).

– Midlobe of mesoscutum with 2 pairs of setae; head with vertical furrow between occiput and foramen magnum .... ***Teleopterus*** Silvestri[1]

Fauna: 2 spp. **Hosts**: Coleoptera. (See Hansson 1994*b*.)

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[1] After this key was completed Hansson (1996*a*) synonymized *Teleopterus* under *Asecodes* Förster (see couplet 132).

129(127) Clypeus distinct, separated from lower face by distinct sutures or different color (Fig. 242) 130

– Clypeus not distinct, not separated from lower face by sutures or by different color (Figs. 243, 252, 253) 132

130(129) Head with occiput sharply margined behind ocelli; gaster distinctly separated from propodeum by petiole (Fig. 251); notauli often distinctly grooved posteriorly (Fig. 258) .... ***Holcopelte*** Förster

Key: Hansson (1988*b*). **Fauna**: 2 spp. **Hosts**: gall-forming Cecidomyiidae.

– Head with occiput rounded behind ocelli; gaster appearing broadly joined to propodeum, the petiole reduced to narrow dorsal strip; notauli not grooved posteriorly 131

131(130) Head with vertex projecting anterolaterally as 2 horn-like points forward of eye (Figs. 272, 273); scape and first 2 flagellar segments flattened (Fig. 293); forewing (Fig. 285) longitudinally infuscated .... ***Callifrons*** Schauff, Yoshimoto & Hansson

Fauna: 1 sp., *C. maculata* Schauff, Yoshimoto & Hansson (1994), in USA (FL, KS).

– Head with vertex not projecting anterolaterally; scape and flagellar segments not flattened; forewing usually hyaline, but if infuscated then not in a longitudinal pattern .... ***Omphale*** Haliday[2]

Key: Hansson (1996*b*). **Fauna**: 57 described spp., common and widespread. **Hosts**: Cecidomyiidae.

132(129) Scrobes appearing as distinct ∧-shaped sutures at least apically, not meeting before juncture with frontofacial sutures (Fig. 270); flagellum with all anelli small and ring-like; body dark brown to black, and smooth or with very weak sculpture .... ***Asecodes*** Förster[3]

Key: Hansson (1996*a*). **Fauna**: 5 spp. **Hosts**: Chrysomelidae and Tenthredinidae. (See Hansson 1994*b*.)

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[2] After this key was completed Hansson (1996*c*) described the new genus *Perditorulus* and differentiated it from *Omphale* in his discussion of the genus; three of the 33 newly described species occur north of Mexico.

[3] After this key was completed Hansson (1996*a*) removed *Ionympha* Graham from synonymy with *Asecodes* and gave features to differentiate the genera; there are two species in the Nearctic, *I. carne* (Walker) and *I. ochus* (Walker) (see Hansson 1988*b*, 1996*a*).

– Scrobal grooves only indicated as inverted Y-shaped depressions or not meeting prior to joining frontofacial sutures (Fig. 269); flagellum with third anellus triangular; body usually metallic, at least on mesosoma dorsally, and at least thorax dorsally with some obvious sculpture 133

133(131) Frontofacial sutures nearly straight (Fig. 269); postmarginal vein usually about as long as stigmal vein; mesosoma dorsally often with pits (Fig. 268) .... ***Achrysocharoides*** Girault

Key: Kamijo (1991). **Fauna**: 18 spp. **Hosts**: leaf-mining Lepidoptera, especially *Phyllonorycter* (Gracillariidae).

– Frontofacial sutures ∧-shaped; postmarginal vein shorter than stigmal vein; mesosoma dorsally never with pits 134

134(132) Mesopleuron with transepimeral sulcus weakly curved or straight (Fig. 300); forewing usually with a single line of setae extending apically from stigma; flagellum with capitate peg sensilla (Fig. 301) rounded apically (mushroom shaped) (sensilla visible only in slide preparations) .... ***Closterocerus*** Westwood

Key: Hansson (1994*a*). **Fauna**: 21 spp. **Hosts**: a wide variety of insects, including Coleoptera, Homoptera (Psyllidae), leaf-mining Diptera and Lepidoptera, and Hymenoptera (including eggs of Symphyta).

– Mesopleuron with transepimeral sulcus strongly arched (Fig. 299); forewing without a line of setae extending apically from stigma; flagellum with capitate peg sensilla flattened apically (Fig. 302) .... ***Neochrysocharis*** Kurdjumov

Key: Hansson (1995*a*). **Fauna**: 18 spp. **Hosts**: Coleoptera, Diptera, Hymenoptera, and Lepidoptera.

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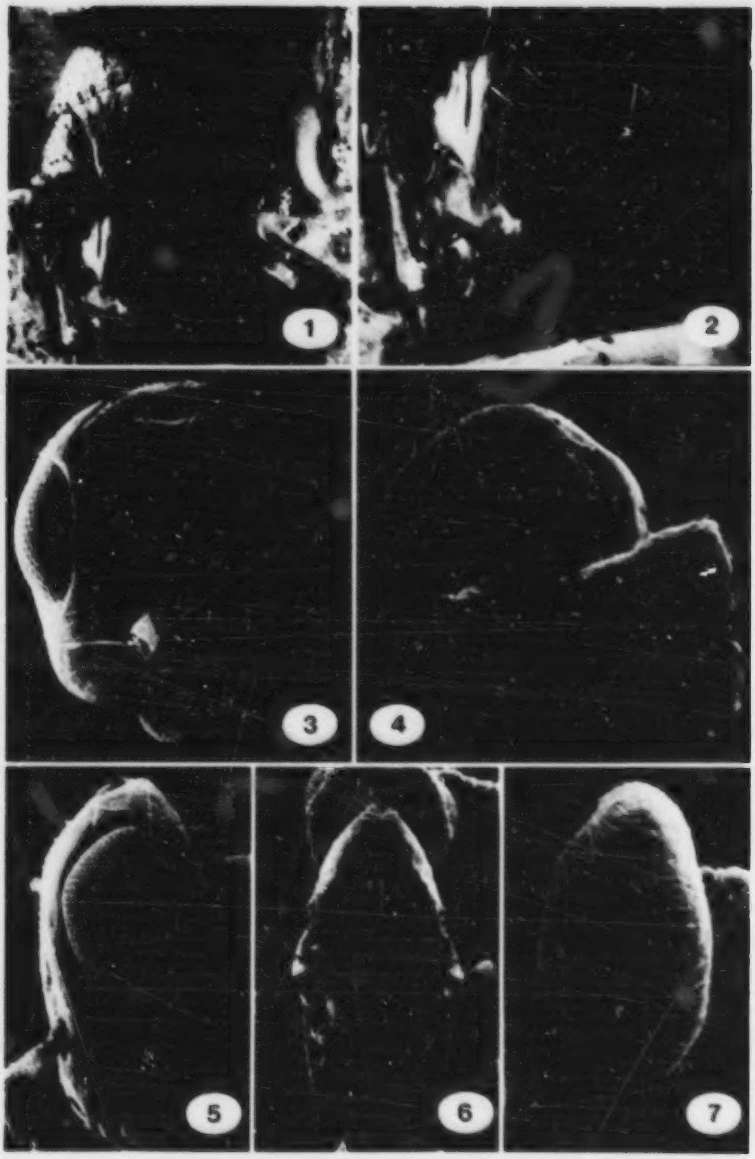
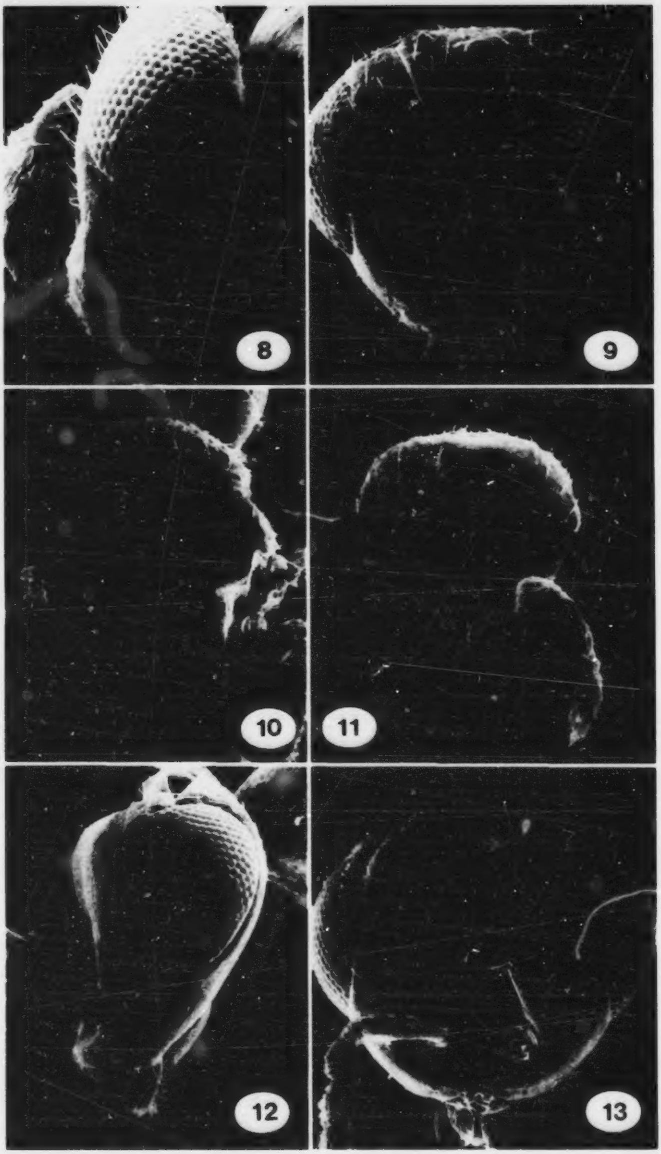
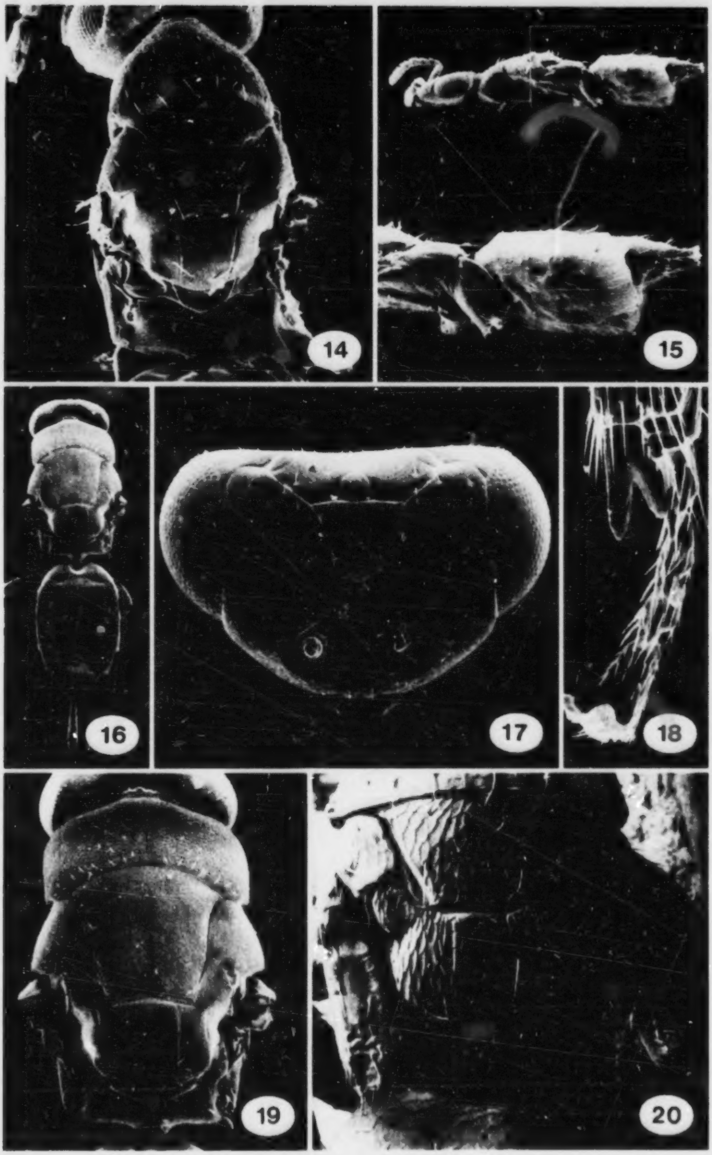


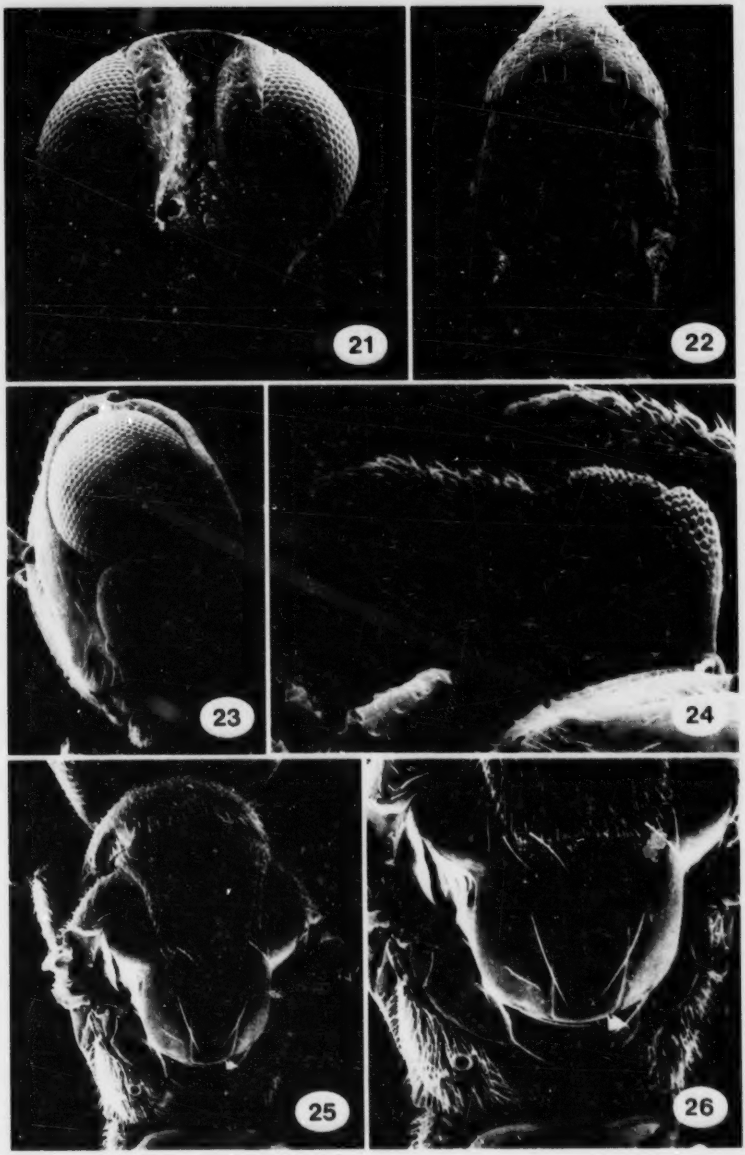
Figs. 1–7. 1 and 2, ***Kocourekia debilis*** (Ratzeburg): 1, mesosoma; 2, scutellum and propodeum. 3–5, ***Melittobia acasta*** (Walker): 3, ♀ head; 4, ♂ head and antenna; 5, ♀ head. 6, ***M. digitata*** Dahms, mesosoma. 7, ***M. acasta***, ♂ head.



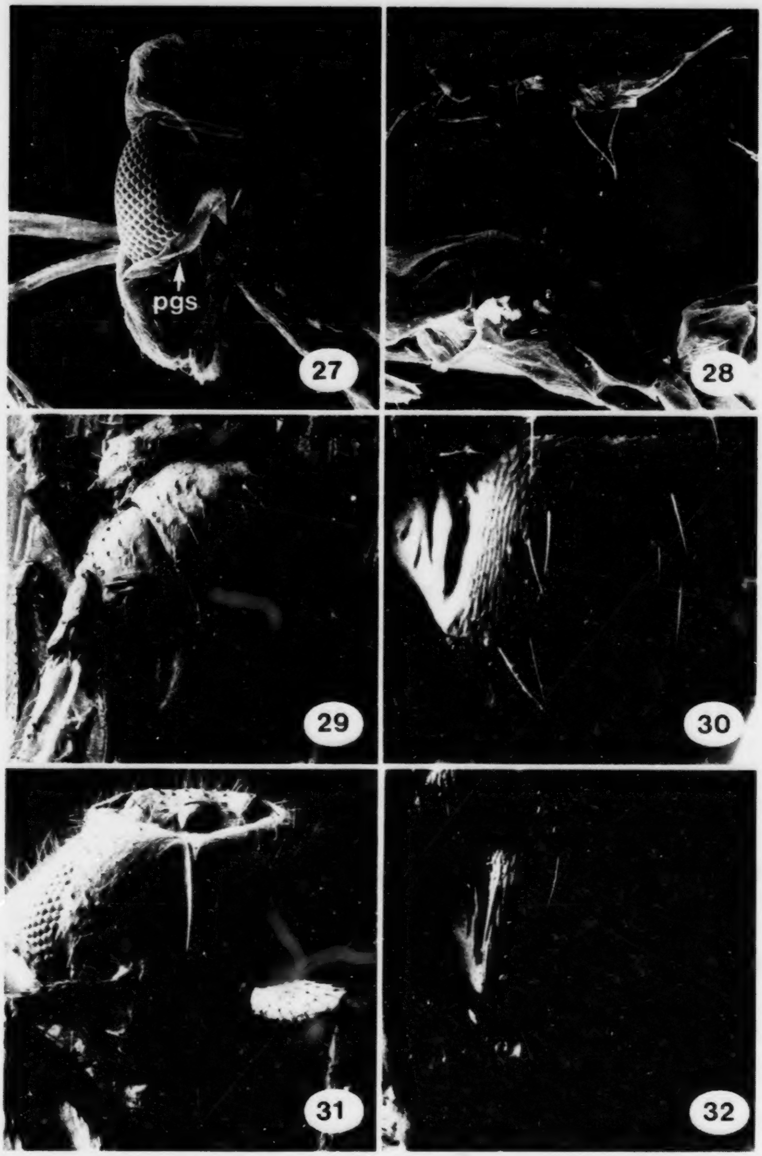
Figs. 8–13. 8–11, ***Tachinobia repanda*** Bouček: 8, head; 9, ♀ head; 10, mesosoma; 11, ♂ head and antenna. 12–13, ***Pronotalia carlinarum*** (Szelényi & Erdös): 12, head; 13, head.



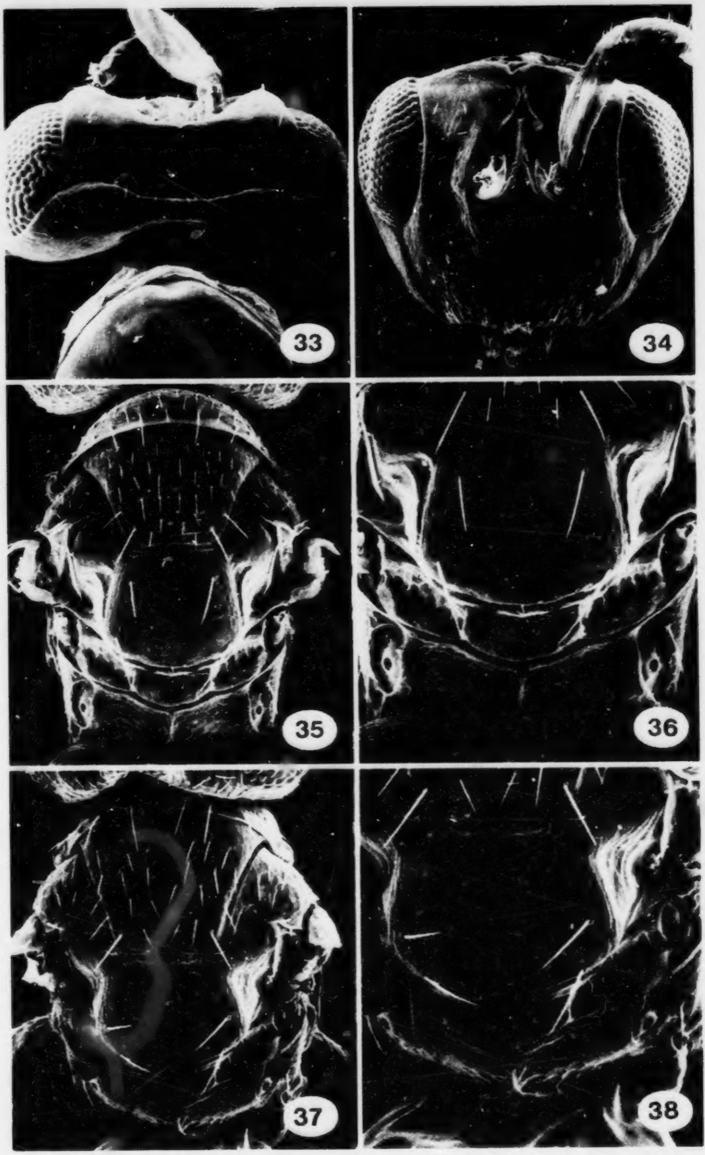
Figs. 14–20. 14–15, ***Pronotalia carlinarum*** (Szelényi & Erdös): 14, mesosoma; 15, body. 16–19, ***Crataepus marbis*** (Walker): 16, body; 17, head; 18, protibial spur and tarsus; 19, thorax. 20, ***Exalarius huachucensis*** LaSalle, mesosoma.



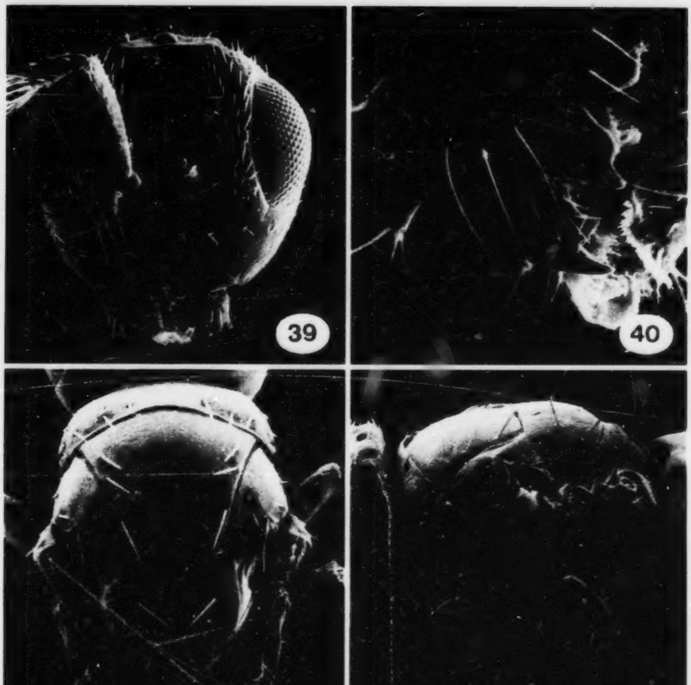
Figs. 21–26. 21–22, ***Apterastichus oculatus*** LaSalle: 21, head; 22, mesosoma. 23–24, ***Quadrastichodella nova*** Girault: 23, head; 24, antenna. 25–26, ***Eriastichus cigdemae*** LaSalle: 25, mesosoma; 26, scutellum–propodeum.



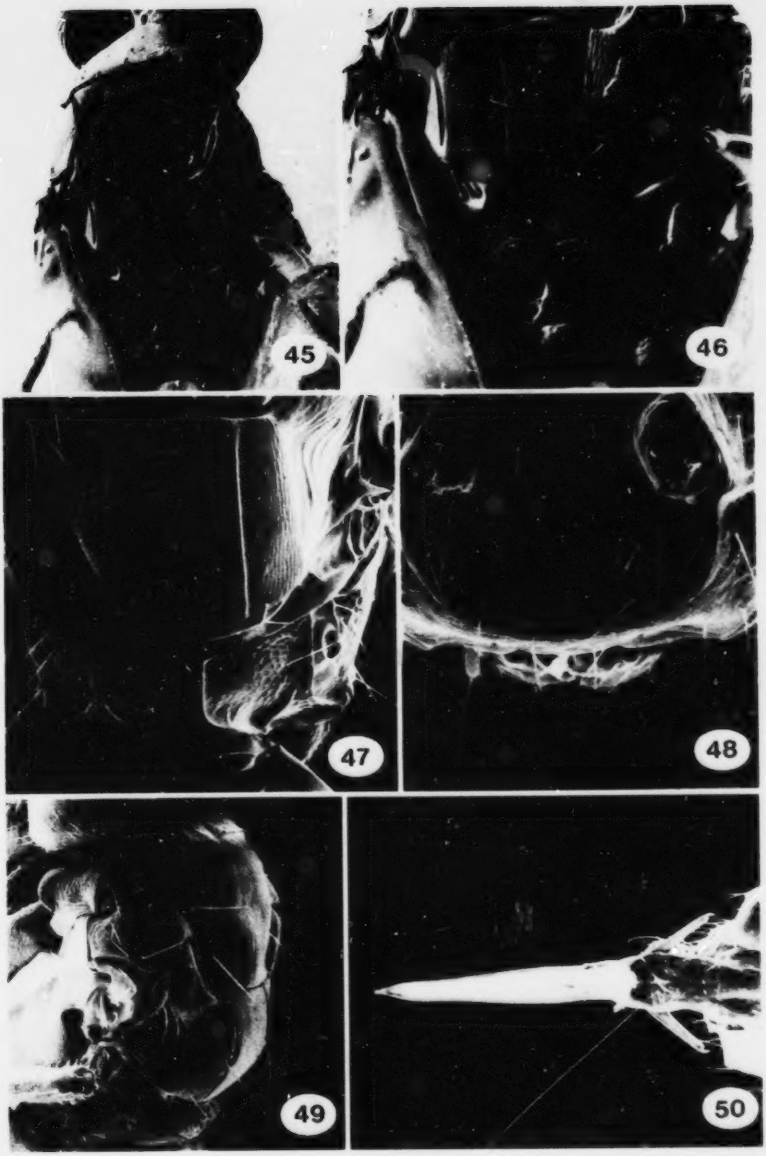
Figs. 27–32. 27–28, ***Henryana magnifica*** Yoshimoto: 27, head; 28, body. 29–31, ***Mesofrons villosus*** LaSalle: 29, mesosoma; 30, scutellum; 31, head. 32, ***Peckelachertus diprioni*** Yoshimoto, scutellum.



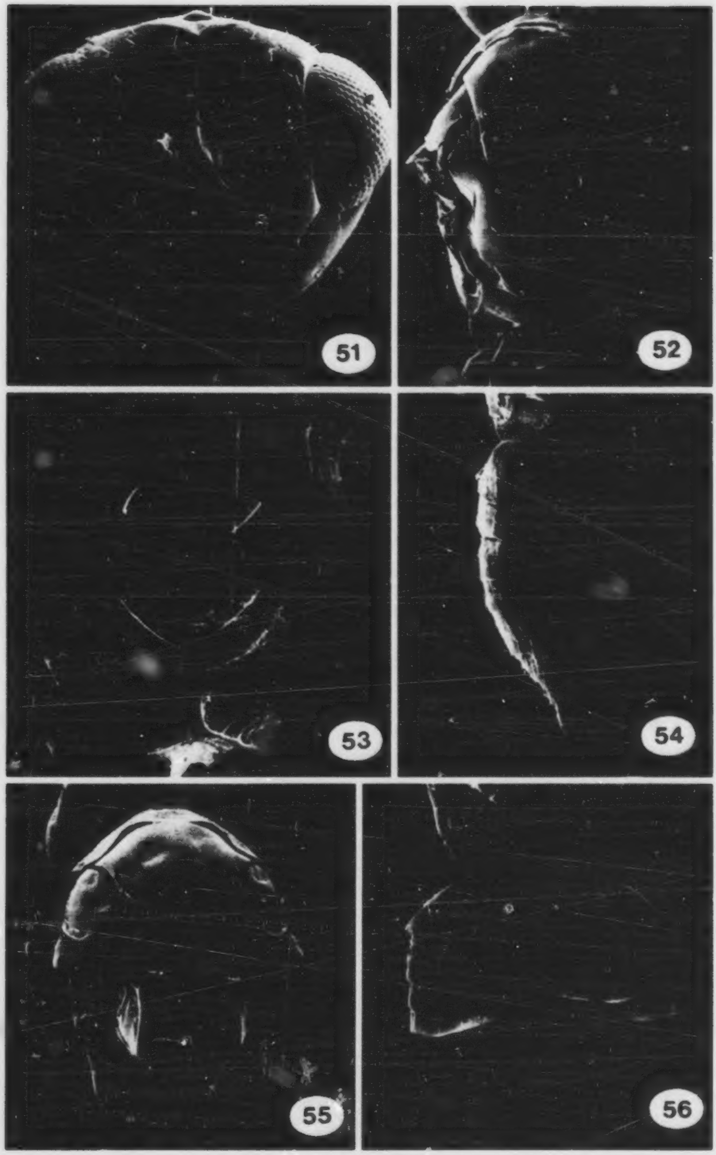
Figs. 33–38. 33–34, ***Oncastichus goughi*** Headrick & LaSalle: 33, head; 34, head. 35–36, ***Cucarastichus texanus*** LaSalle: 35, mesosoma; 36, scutellum–propodeum. 37–38, ***Careostrix yoshimotoi*** LaSalle: 37, mesosoma; 38, scutellum–propodeum.



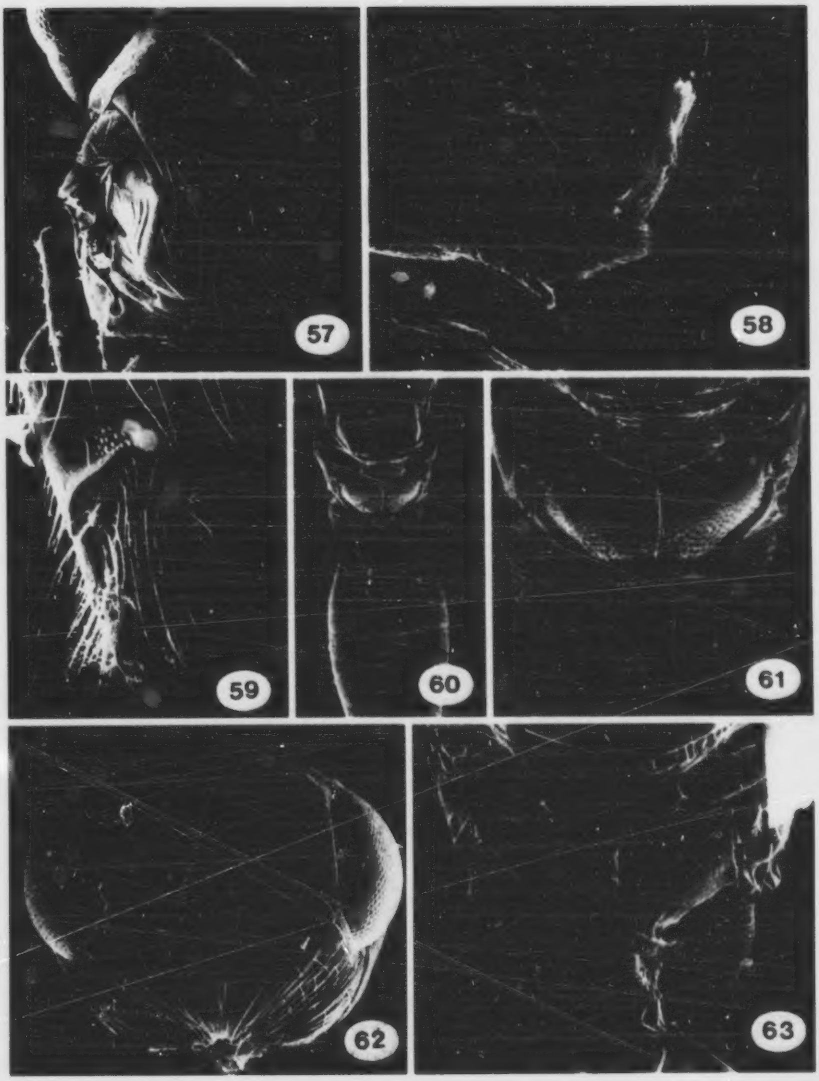
Figs. 39–44. 39–42, ***Chytrolestes alibaba*** LaSalle: 39, head; 40, mandible; 41, mesosoma; 42, mesosoma. 43–44, ***Chaenotetrastichus semiflavus*** (Girault): 43, mesosoma; 44, scutellum–base of gaster.



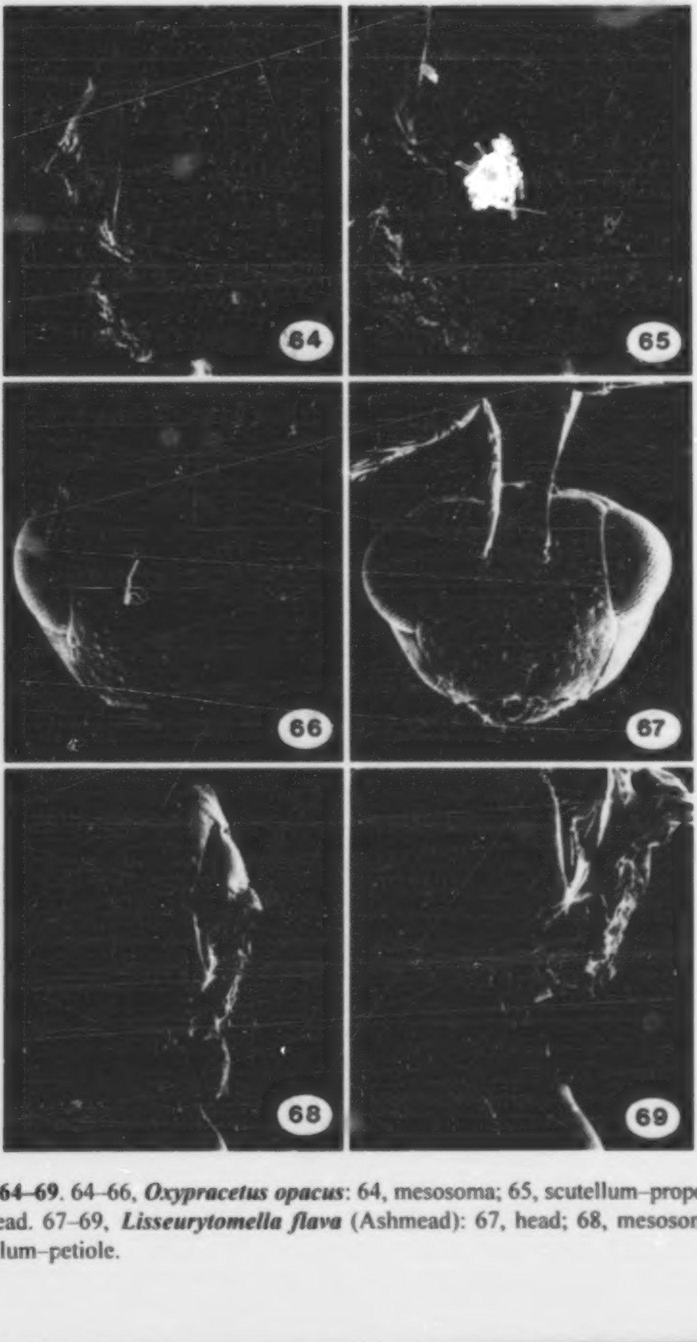
Figs. 45–50. 45–46, ***Kostjukovius grahami*** LaSalle: 45, mesosoma; 46, scutellum–propodeum. 47, ***Tetrastichus***, scutellum–propodeum. 48–50, ***Tamarixia***: 48, lower face; 49, mesosoma; 50, ♂ genitalia.



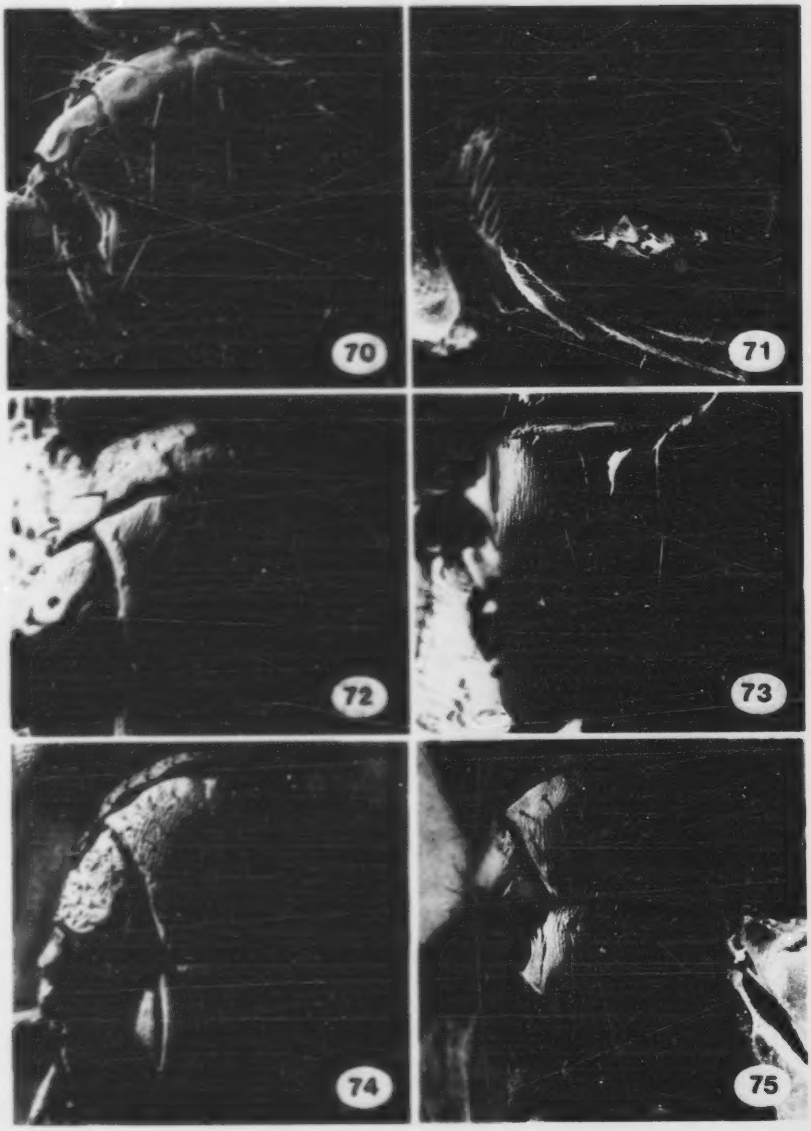
Figs. 51–56. 51–54, ***Quadrastichus***: 51, head; 52, mesosoma; 53, scutellum–propodeum; 54, gaster. 55–56, ***Oomyzus scaposus*** (Thompson): 55, mesosoma; 56, gaster.



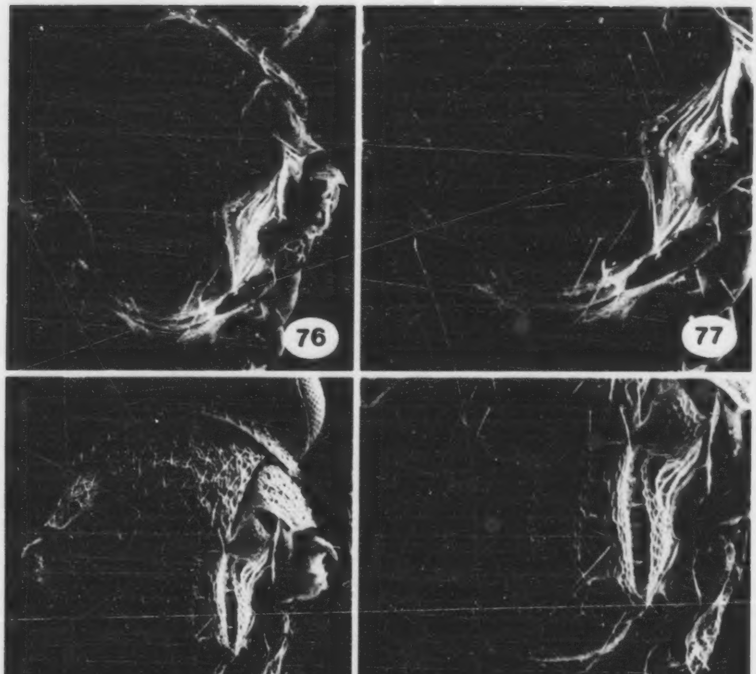
Figs. 57–63. 57–59, ***Phymastichus xylebori*** LaSalle: 57, mesosoma; 58, gaster; 59, gastral apex (dorsal). 60–61, ***Paragaleopsomyia***: 60, scutellum–gaster; 61, metanotum–petiole. 62–63, ***Ceratoneura***: 62, head; 63, metanotum–petiole.



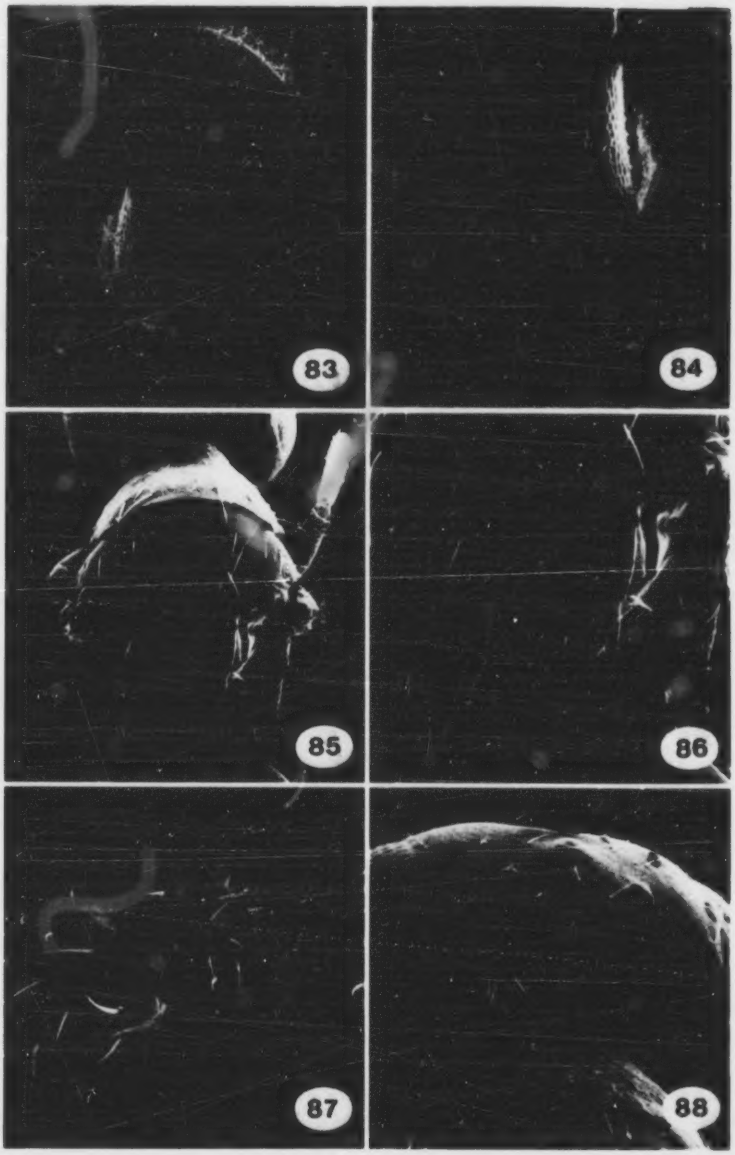
Figs. 64–69. 64–66, ***Oxypracetus opacus***: 64, mesosoma; 65, scutellum–propodeum; 66, head. 67–69, ***Lisseurytomella flava*** (Ashmead): 67, head; 68, mesosoma; 69, scutellum–petiole.



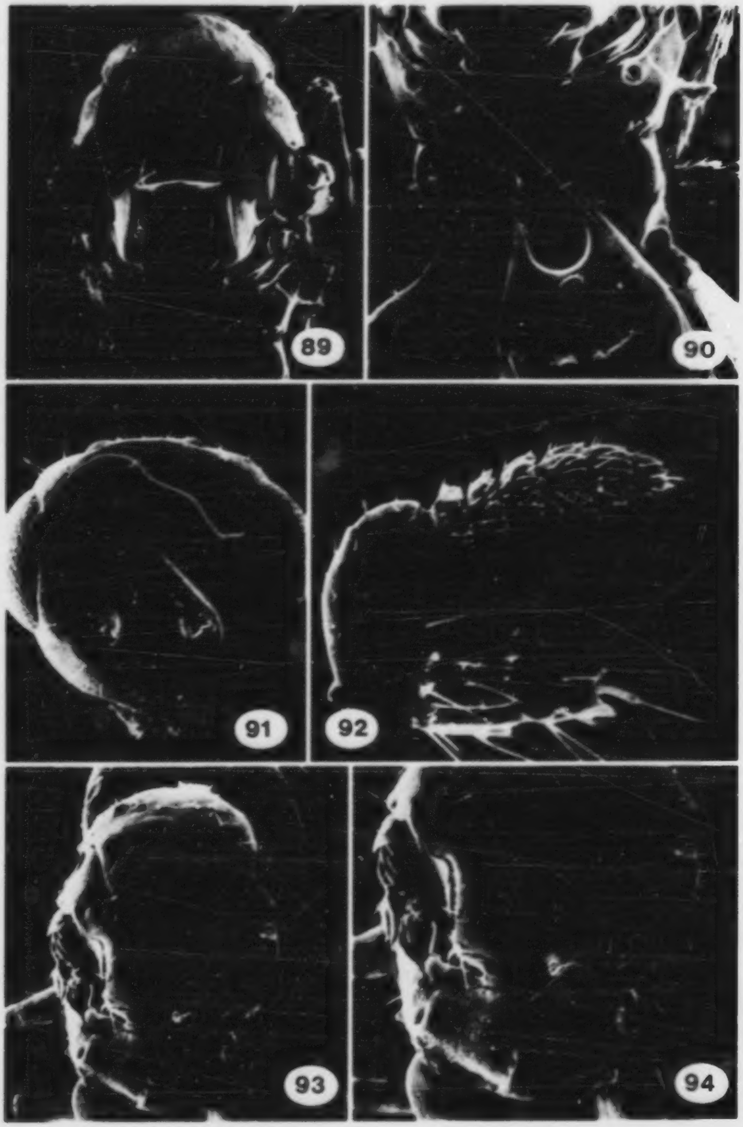
Figs. 70–75. 70–71, ***Pentastichus***: 70, mesosoma; 71, mesosoma. 72–73, ***Hadrotrichodes waukheon*** LaSalle: 72, mesoscutum; 73, scutellum. 74, ***Dapsilothrix jeanae*** LaSalle, thorax. 75, ***Styotrichia quadrata*** LaSalle, mesosoma.



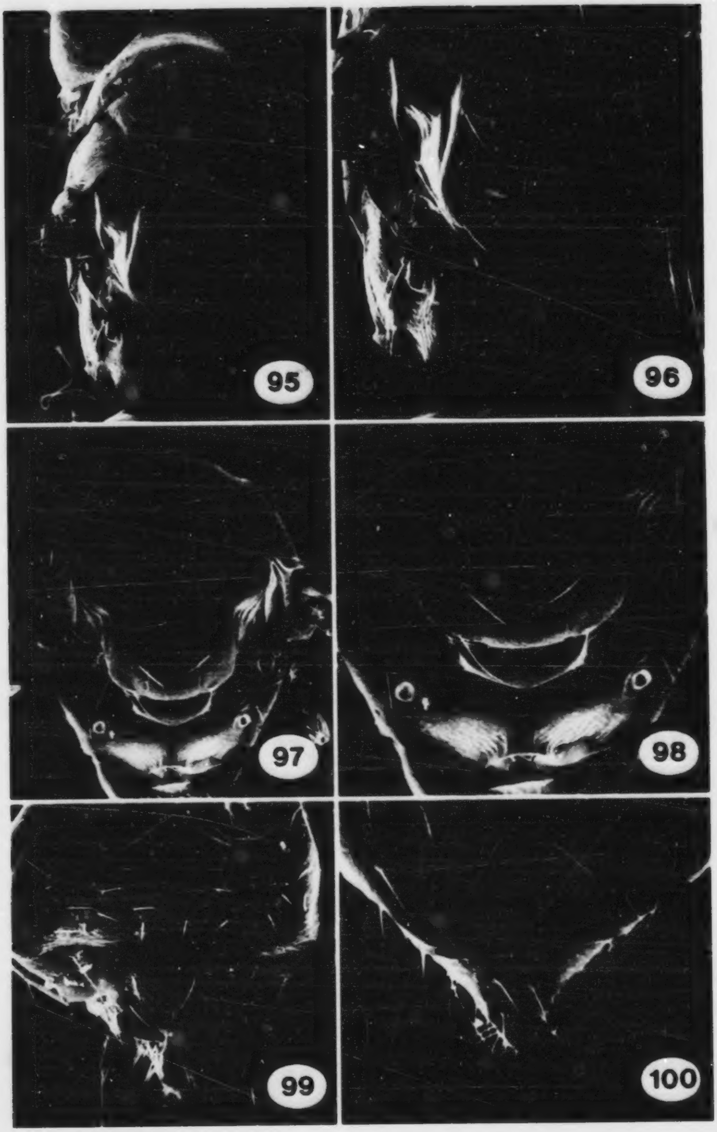
Figs. 76–82. 76–77, ***Comastichus zopheros*** LaSalle: 76, mesosoma; 77, scutellum–propodeum. 78–79, ***Aranobroter rayorae*** LaSalle: 78, mesosoma; 79, scutellum–propodeum. 80–82, ***Galeopsomyia***: 80, head; 81–82, gaster.



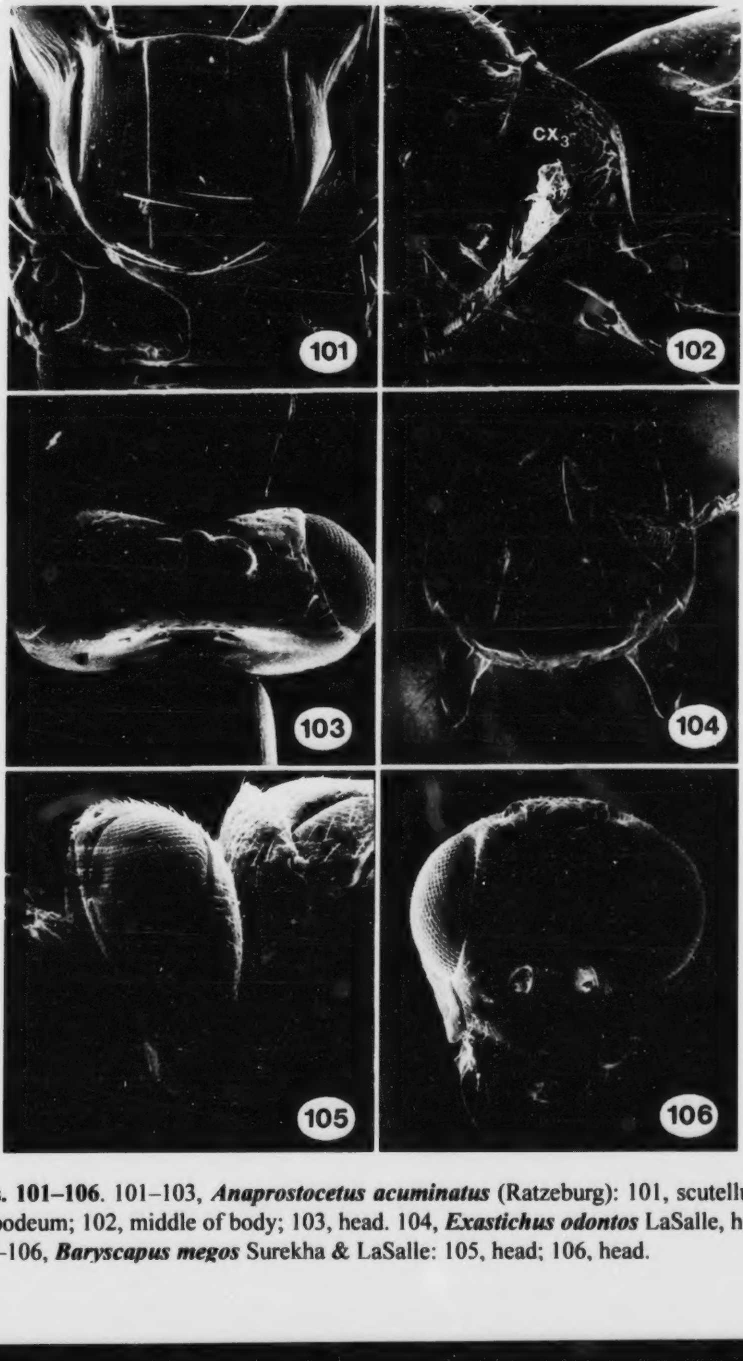
Figs. 83–88. 83–84, ***Galeopsomyia***: 83, mesosoma; 84, scutellum–propodeum. 85–88, ***Tetrastichomyia clisiocampae*** (Ashmead): 85, mesosoma; 86, scutellum–propodeum; 87, anelli; 88, head.



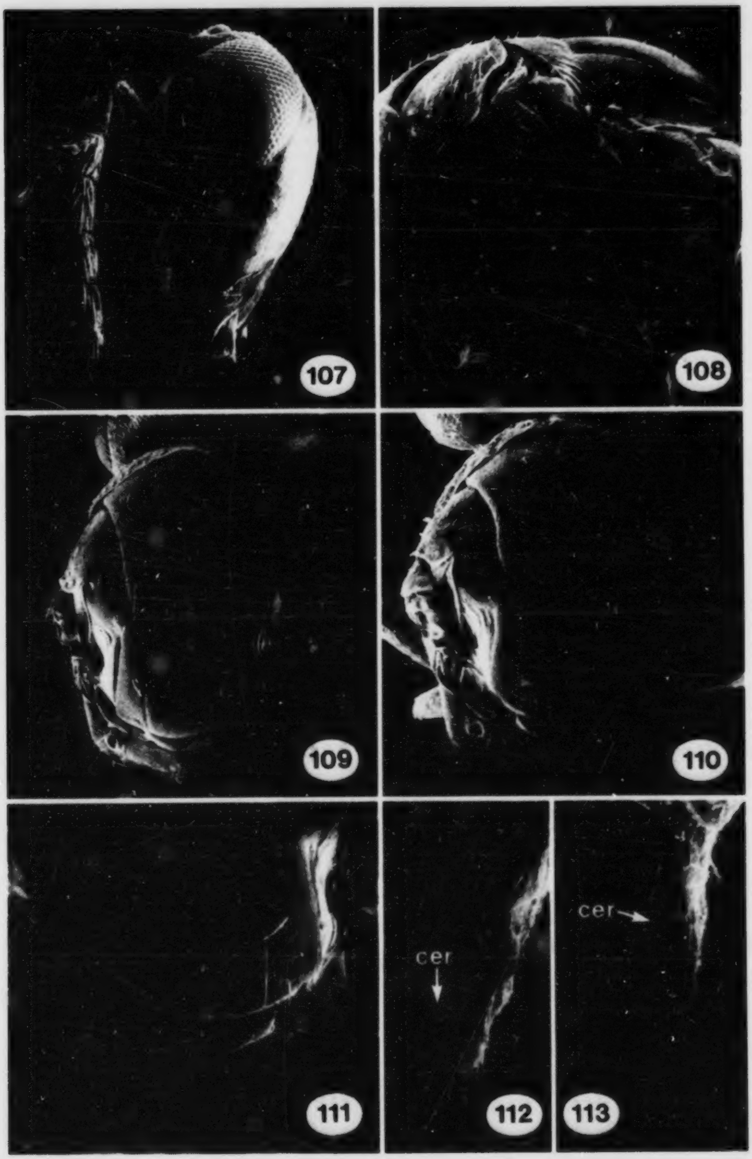
Figs. 89–94. 89–90, ***Thripastichus gentilei*** (Del Guercio): 89, mesosoma; 90, metanotum–base of gaster. 91–94, ***Aceratoneuromyia indica*** (Silvestri): 91, head; 92, antenna (inset: apex of clava); 93, mesosoma; 94, scutellum–propodeum.



Figs. 95–100. 95–96, ***Neotrichoporoides viridimaculatus*** (Fullaway): 95, mesosoma; 96, scutellum–propodeum. 97–100, ***Minotetrastichus frontalis*** (Nees): 97, mesosoma; 98, scutellum–propodeum; 99, lower face; 100, gastral apex (dorsal).



Figs. 101–106. 101–103, ***Anaprostocetus acuminatus*** (Ratzeburg): 101, scutellum–propodeum; 102, middle of body; 103, head. 104, ***Exastichus odontos*** LaSalle, head. 105–106, ***Baryscapus megos*** Surekha & LaSalle: 105, head; 106, head.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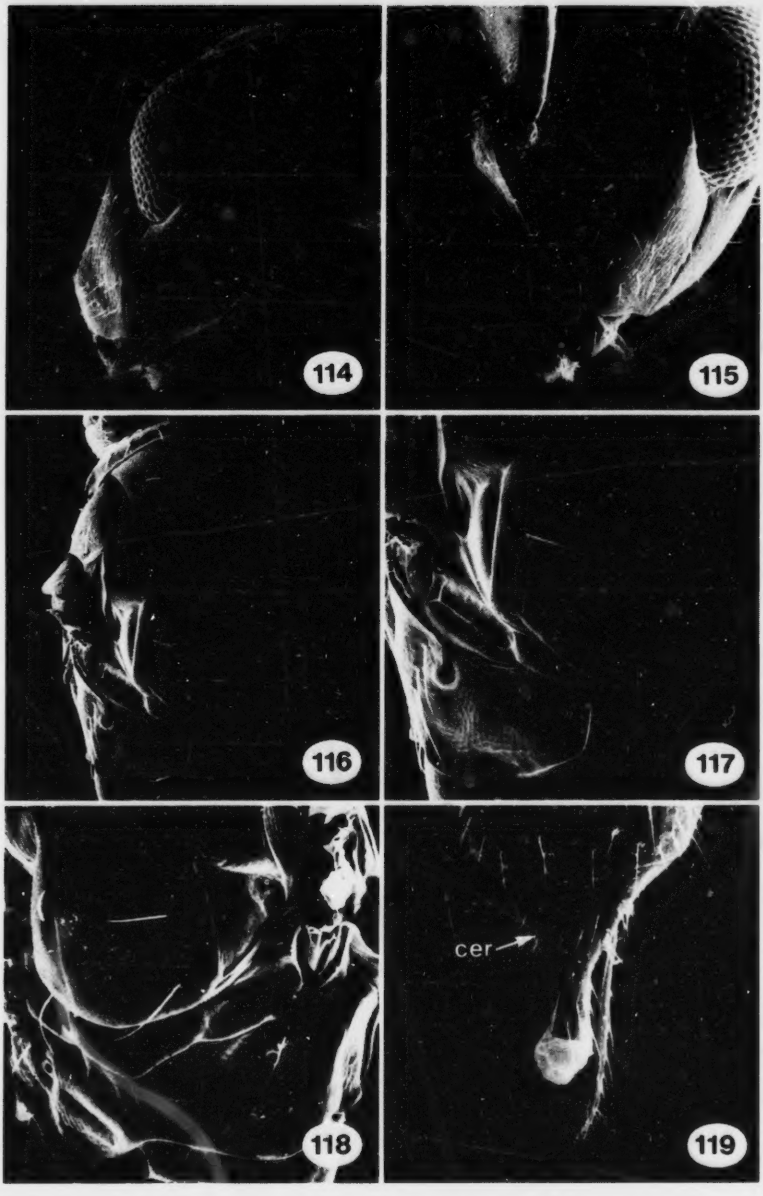
Figs. 107–113. ***Baryscapus***: 107, head and antenna; 108, mesosoma; 109–110, mesosoma; 111, scutellum–propodeum; 112–113, gastral apex: 112, dorsolateral; 113, lateral.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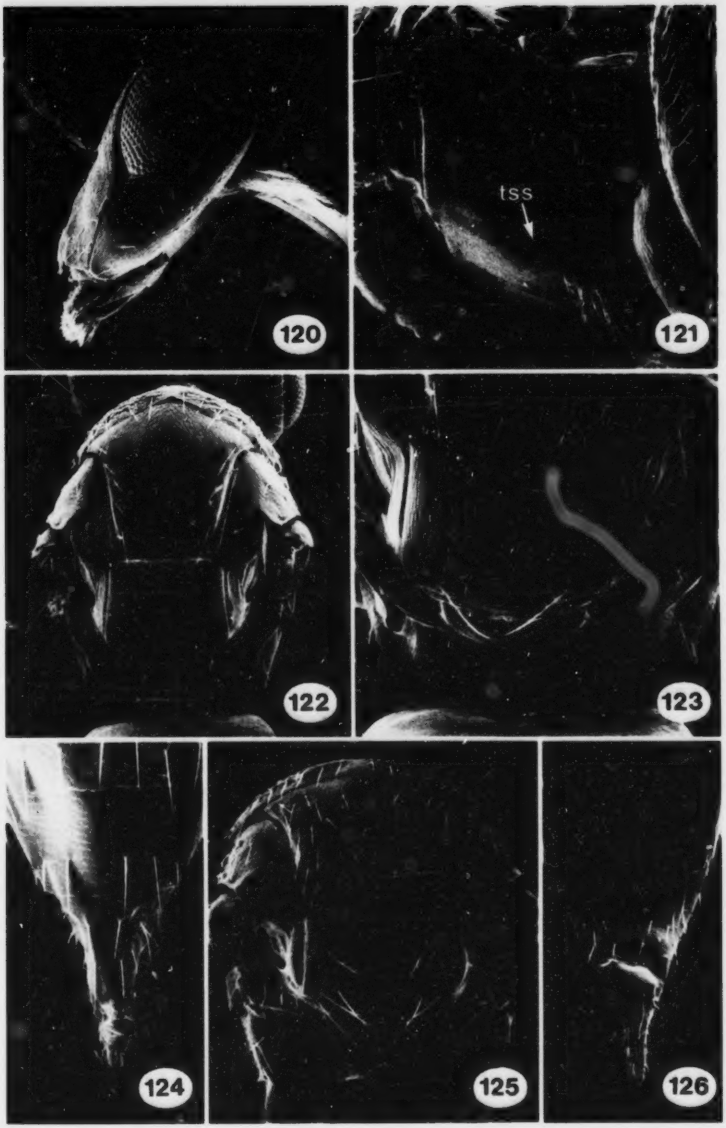
Figs. 114–119. ***Aprostocetus* (*Ootetrastichus*)**: 114, head; 115, face; 116, mesosoma; 117–118, scutellum–propodeum; 119, gastral apex (dorsal).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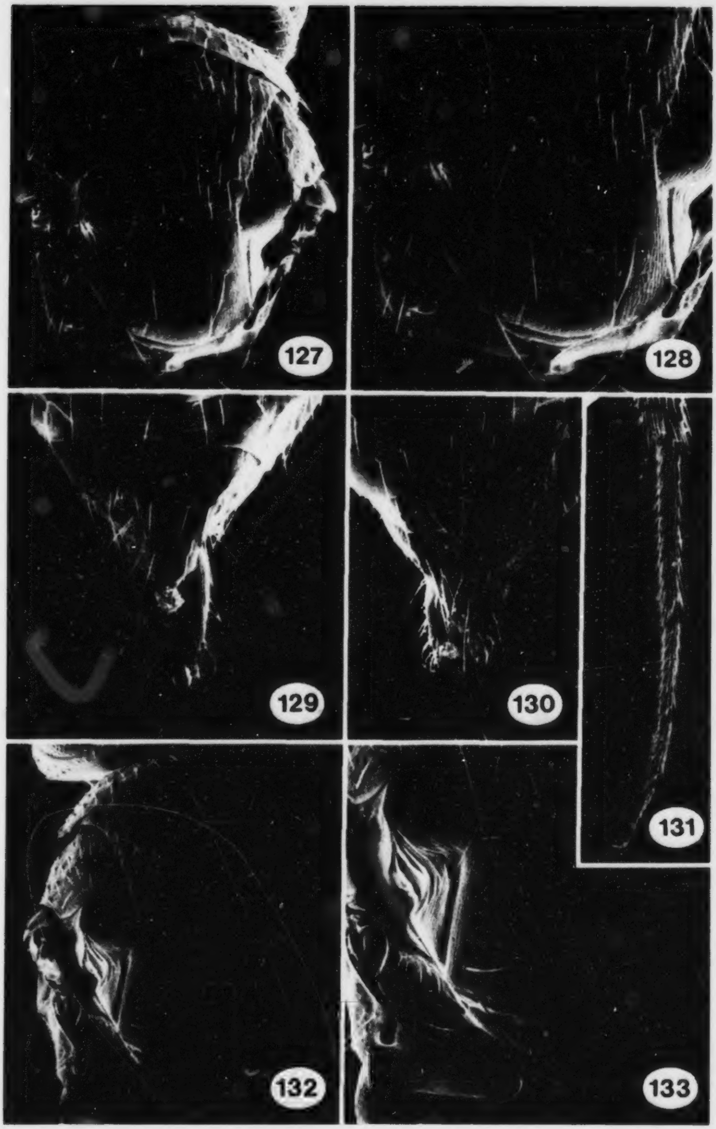
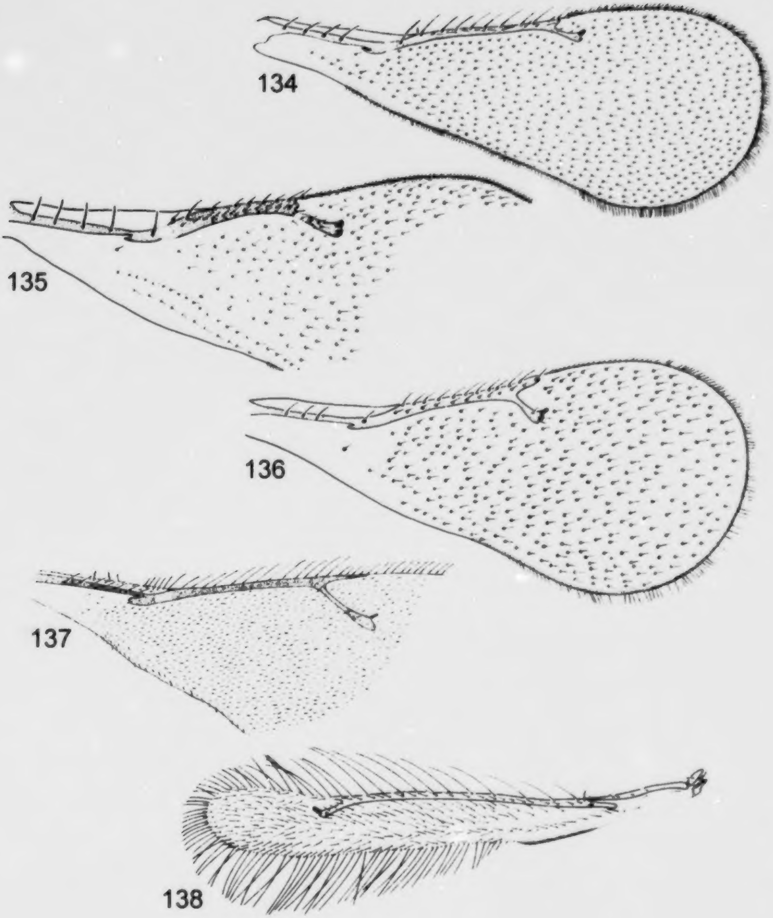
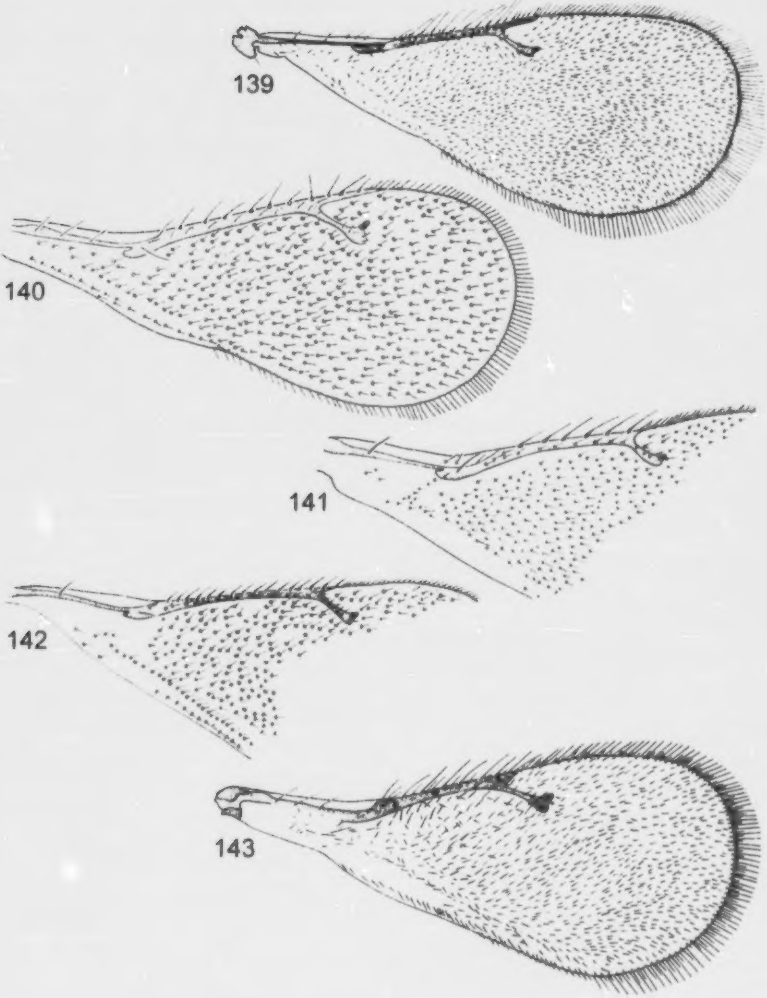
Figs. 120–126. 120–124, ***A.* (*Aprostocetus*) *hibus*** (Burks): 120, head; 121, mesosomal pleura; 122, mesosoma; 123, scutellum–propodeum; 124, gastral apex (dorsal). 125–126, ***A.* (*A.*) *homeri*** (Girault): 125, mesosoma; 126, gastral apex (dorsal).



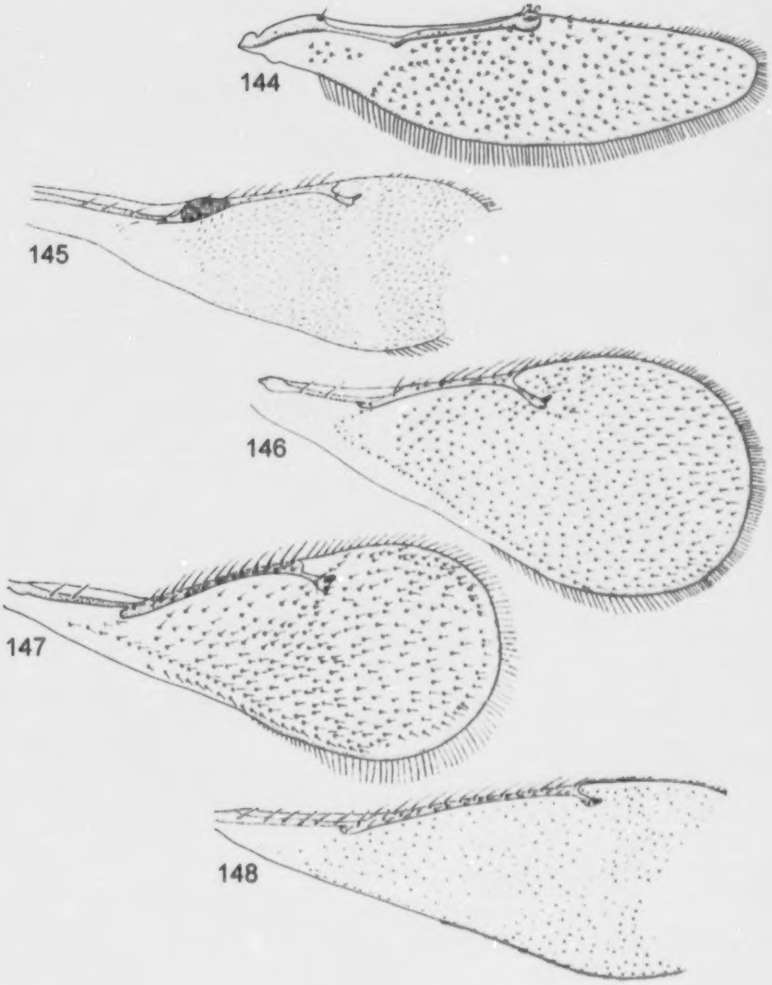
Figs. 127–133. 127–130, ***Aprostocetus* (*Quercastichus*)**: 127, mesosoma; 128, scutellum–propodeum; 129–130, gastral apex (dorsal). 131–133, ***A.* (*Tetrastichodes*) *hagenowii*** (Ratzeburg): 131, metatarsus; 132, mesosoma; 133, scutellum–propodeum.



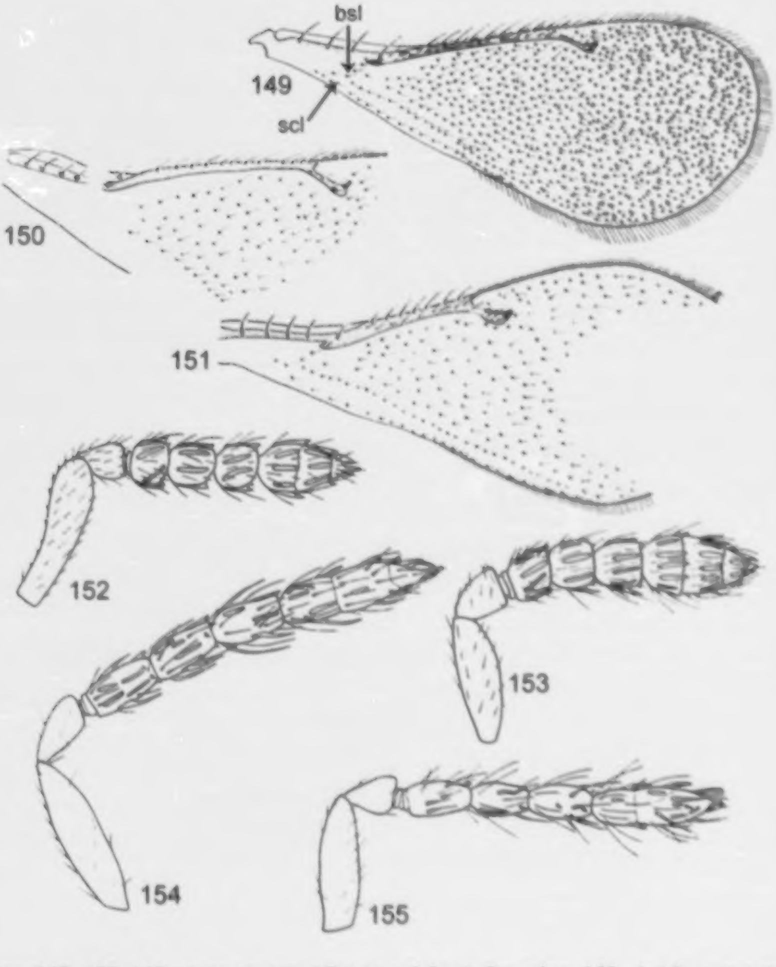
Figs. 134–138. 134, ***Melittobia digitata*** Dahms, forewing. 135, ***Pronotalia carlinarum*** (Szelényi & Erdös), base of forewing. 136, ***Quadrastichodella nova*** Girault, forewing. 137, ***Eriastichus cigdemae*** LaSalle, base of forewing. 138, ***Henryana magnifica*** Yoshimoto, forewing.



Figs. 139–143. 139–140, forewing: 139, ***Oncastichus goughi*** Headrick & LaSalle; 140, ***Careostrix yoshimotoi*** LaSalle. 141–142, base of forewing: 141, ***Tetrastichus***; 142, ***Tamarixia***. 143, ***Phymastichus xylebori*** LaSalle, forewing.



Figs. 144–148. 144, ***Ceratoneura***, hind wing. 145–147, forewing: 145, ***Paraspalangia annulipes*** Ashmead; 146, ***Pentastichus***; 147, ***Thripastichus gentilei*** (Del Guercio). 148, ***Neotrichoporoides viridimaculatus*** (Fullaway), base of forewing.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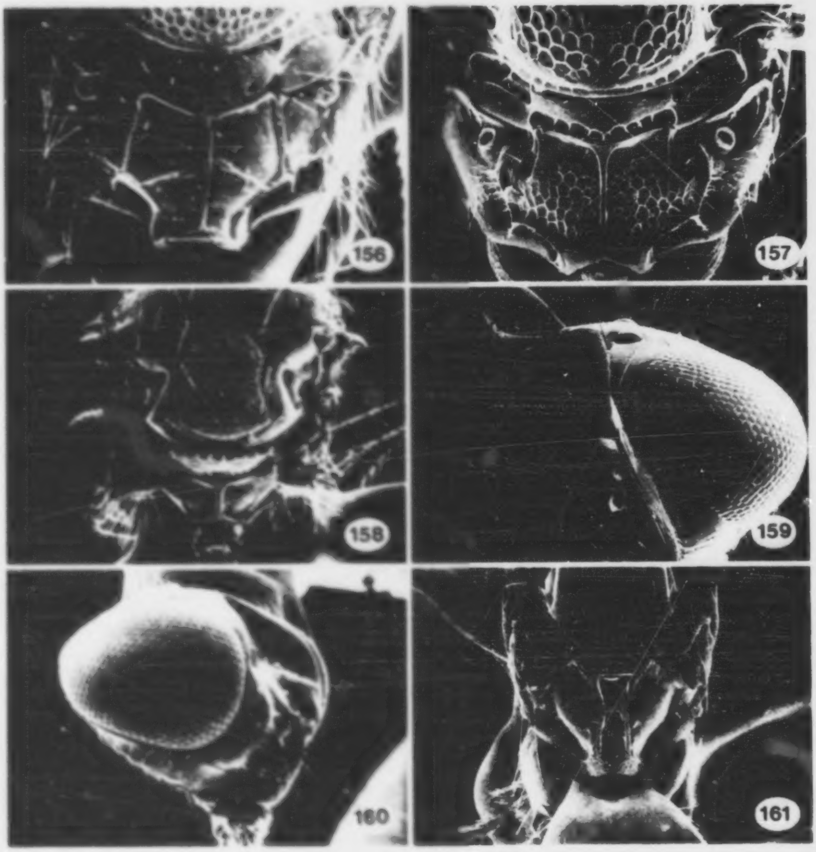
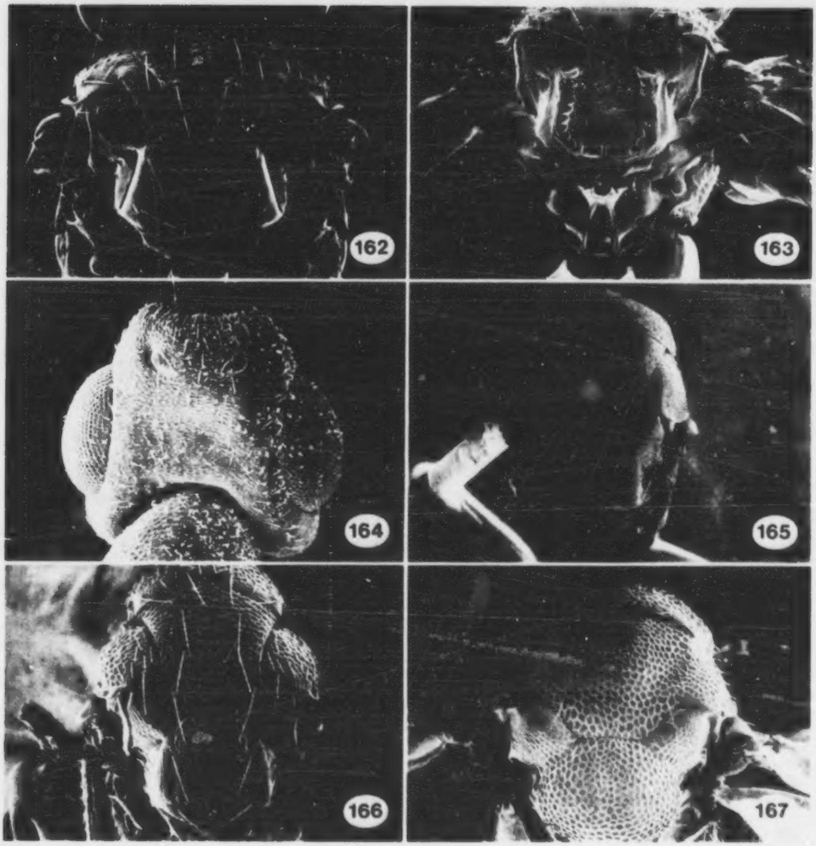
Figs. 149–155. 149, ***Aprostocetus* (*Ootetrastichus*)**, forewing. 150, ***A.* (*Aprostocetus*)** base of forewing. 151, ***Baryscapus***, forewing. 152–155, antenna: 152, ***Melittobia digitata*** Dahms; 153, ***Oomyzus sokolowskii*** (Kurdjumov); 154, ***Quadrastichus***; 155, ***A.* (*Ootetrastichus*)**.



Figs. 156–161. 156–157, metanotum and propodeum: 156, ***Pnigalio***; 157, ***Notanisomorphella*** (species from Madagascar). 158, ***Deutereulophus***, scutellum–propodeum. 159–160, ***Hoplocrepis***, head: 159, posterolateral; 160, anterolateral. 161, ***Stenomesius***, metanotum and propodeum.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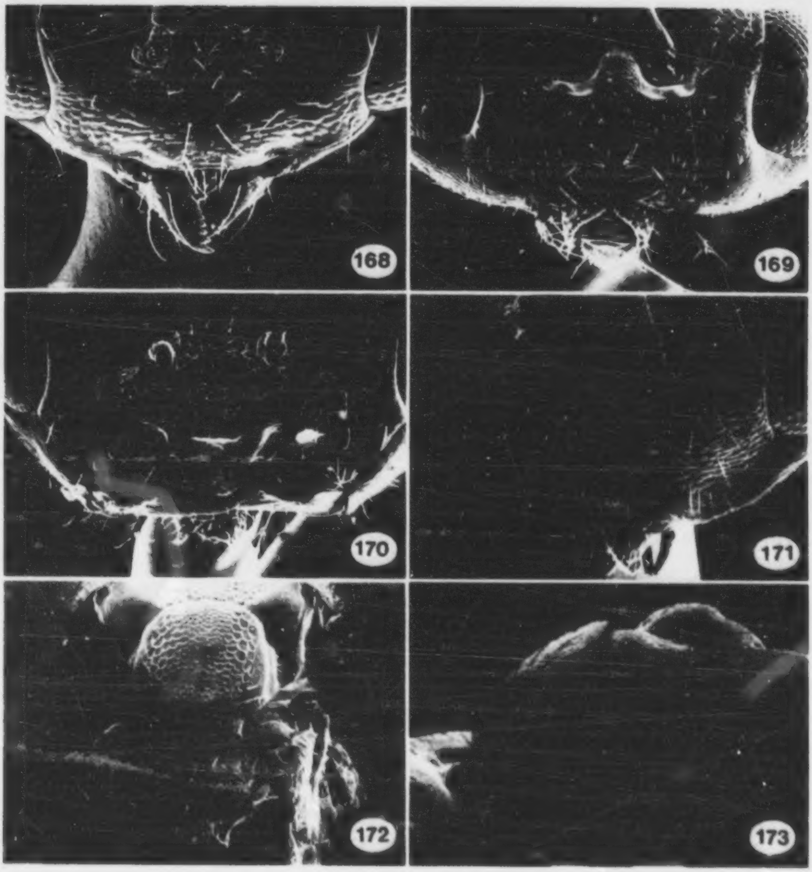
Figs. 162–167. 162–163, mesosoma: 162, ***Euplectrus***; 163, ***Euplectromorpha***. 164, ***Zagrammosoma***, head. 165–167, mesosoma: 165, ***Aulogymnus***; 166, ***Paraolinx***; 167, ***Eulophus***.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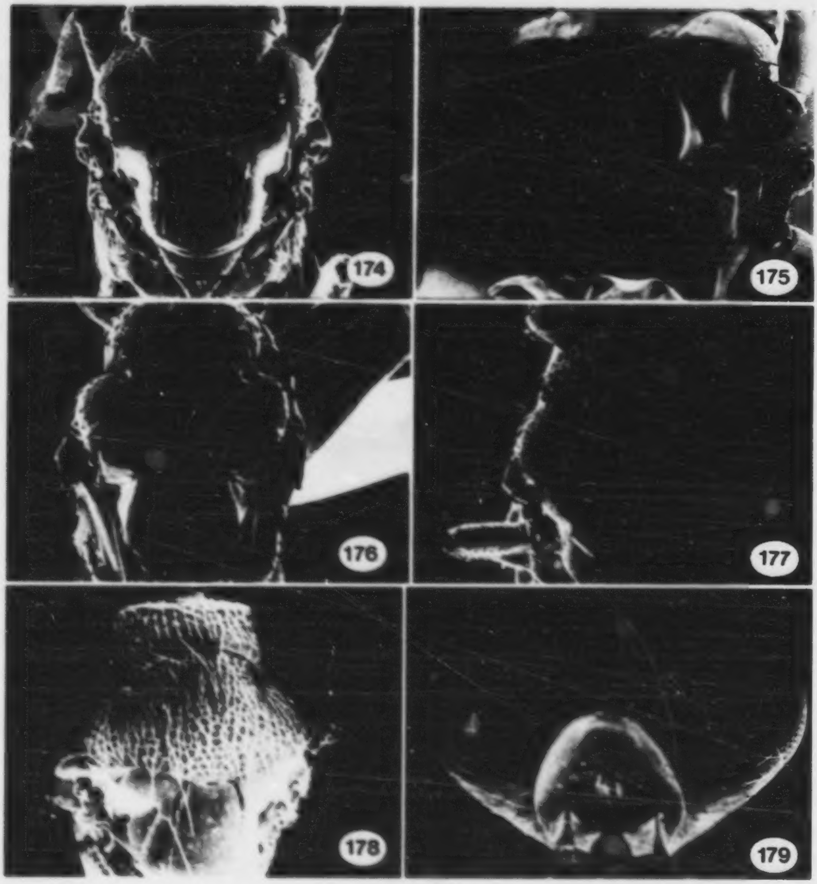
Figs. 168–173. 168–171, lower face and mandibles: 168, ***Paraolinx***; 169, ***Necremnus***; 170, ***Dimmockia***; 171, ***Eulophus***. 172, ***Sympiesis***, scutellum–propodeum. 173, ***Hyssopus***, anterior mesosoma.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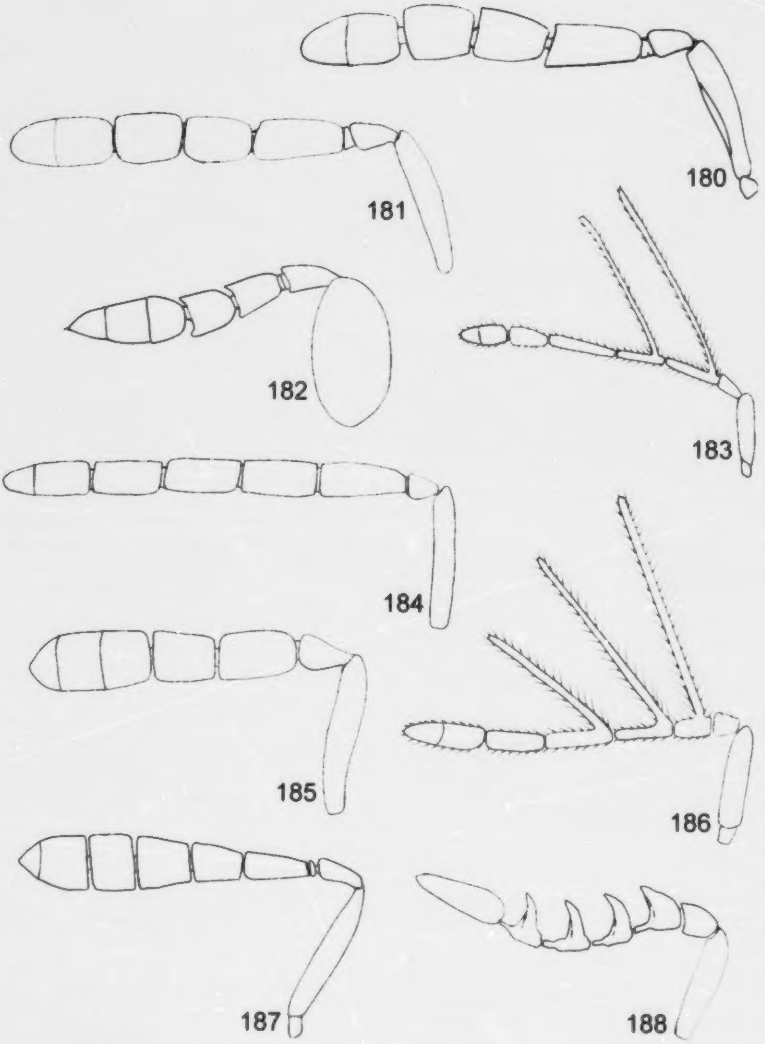
Figs. 174–179. 174–178, mesosoma: 174, ***Miotropis***; 175, ***Hyssopus***; 176, ***Elachertus***; 177, ***Dasyeulophus***; 178, ***Cristelacher***. 179, ***Cristelacher***, head (posterior).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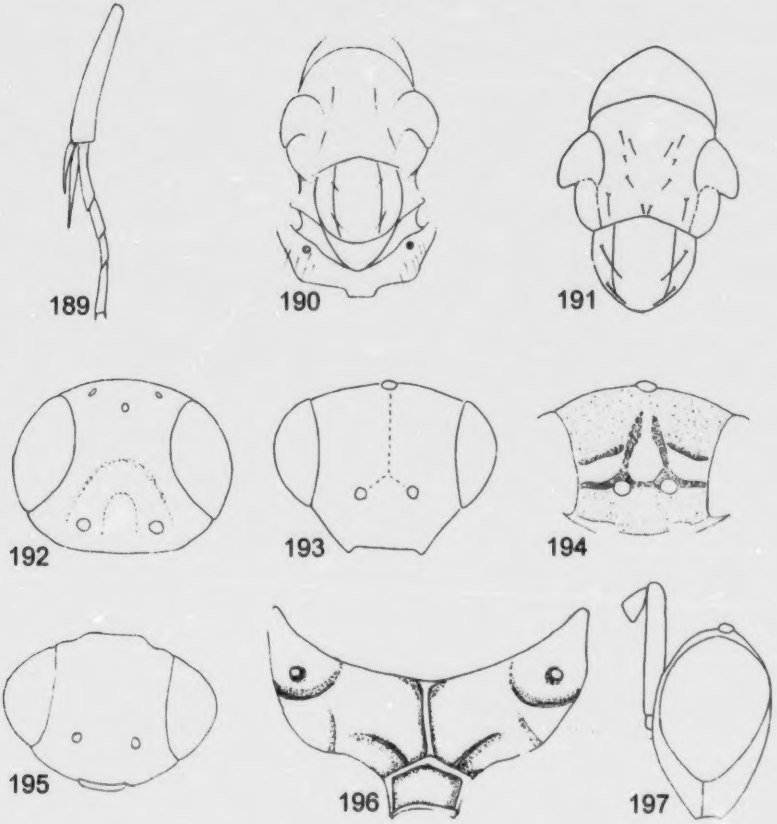
Figs. 180–188. Antenna: 180, ***Sympiesis*** ♀; 181, ***Aulogymnus*** ♀; 182, ***Diaulinopsis*** ♂; 183, ***Dicladocerus*** ♂; 184, ***Sympiesis*** ♀; 185, ***Aulogymnus*** ♀; 186, ***Sympiesis*** ♂; 187, ***Dahlbominus*** ♀; 188, ***Paraolinx*** ♂.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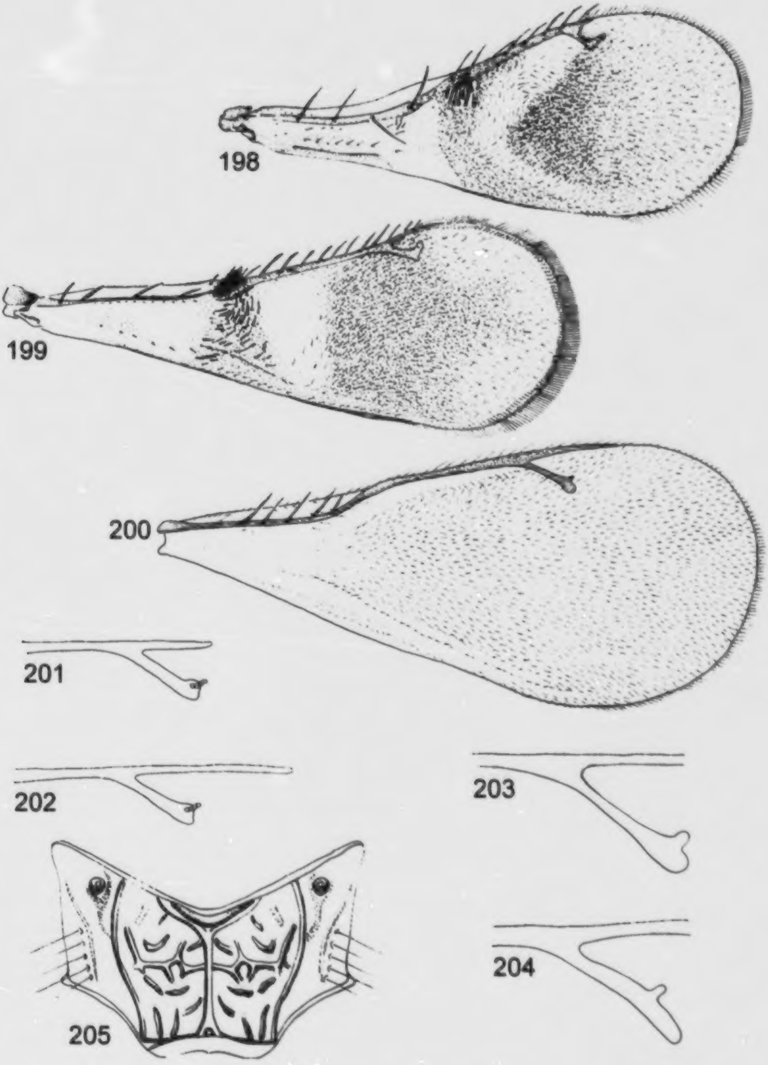
Figs. 189–197. 189, ***Euplectrus***, metatibia. 190–191, mesosoma: 190, ***Diglyphus*** ♀; 191, ***Zagrammosoma*** ♀. 192–195, head: 192, ***Trichospilus*** ♀; 193, ***Elachertus*** ♀; 194, ***Paraolinx*** ♀; 195, ***Grotiusomyia*** ♀. 196, ***Deutereulophis***, propodeum. 197, ***Hemiptarsenus*** ♀, head (lateral).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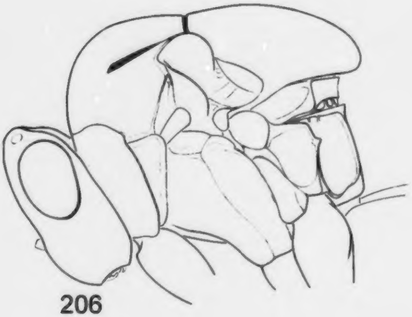
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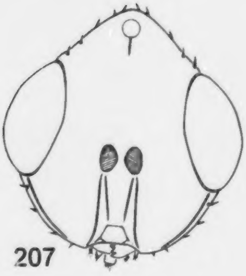
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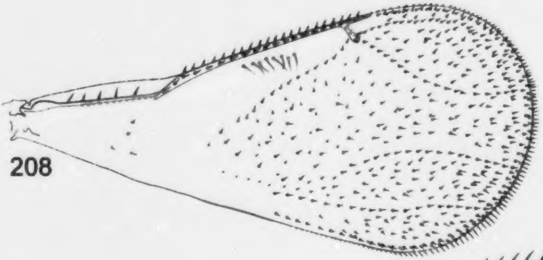
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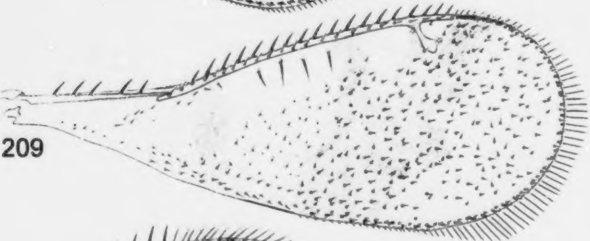
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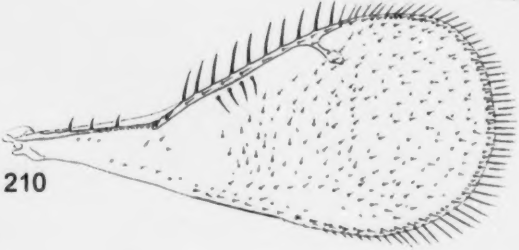
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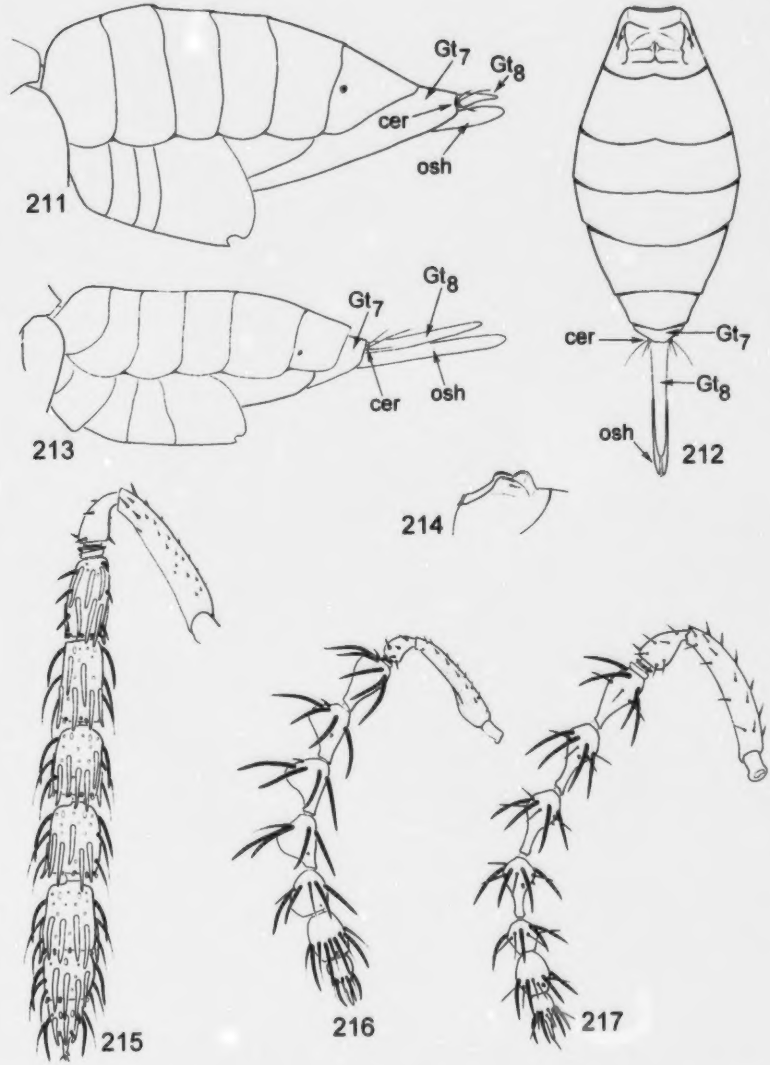
Figs. 206–210. 206, ***Hubbardiella***, head and mesosoma. 207, ***Acrias***, head. 208–210, forewing: 208, ***Euderus***; 209, ***Astichus*** ♀; 210, ***Astichus*** ♂.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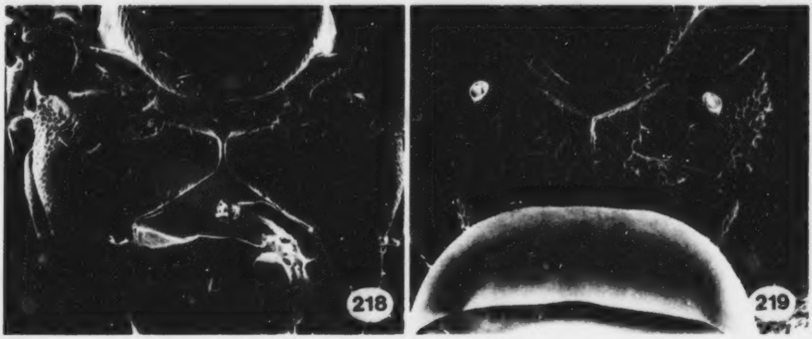
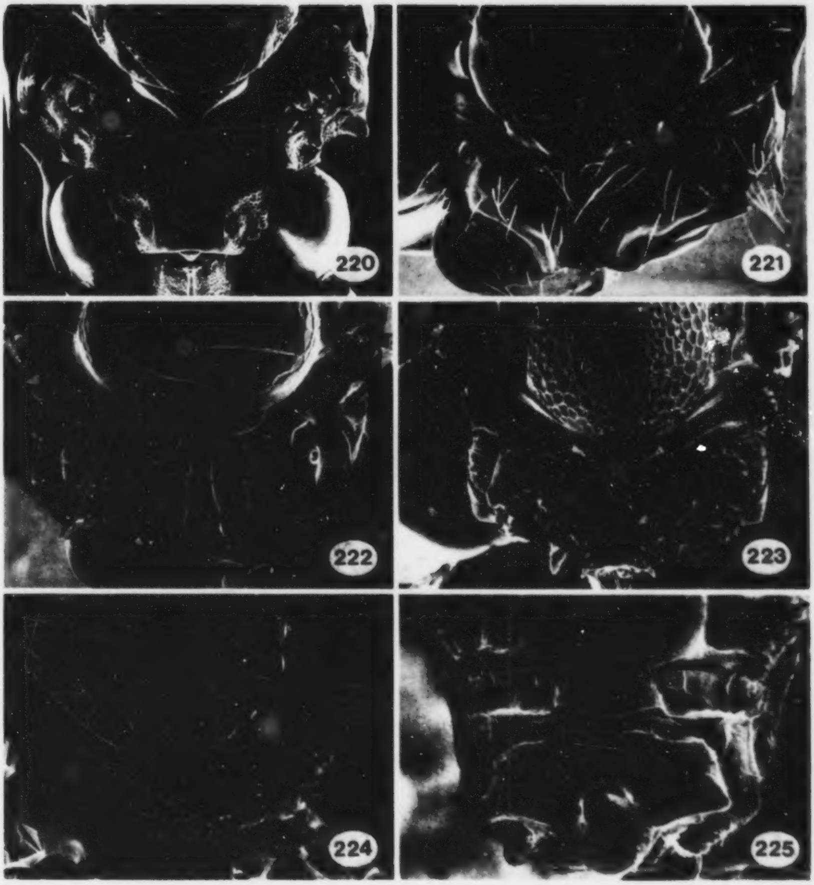
Figs. 211–217. 211–213 gaster: 211, ***Euderus* (*Secodelloidea*)**; 212, ***Allocerastichus***; 213, ***Carlyleia***. 214, ***Allocerastichus***, Gt$_1$ (petiole) (lateral). 215–217, antenna: 215, ***E.* (*Euderus*)** ♀; 216, ***Allocerastichus*** ♂; 217, ***Carlyleia*** ♂.



Figs. 218–219. Metanotum and propodeum: 218, *E.* (***Euderus***); 219, *E.* (***Secodelloidea***).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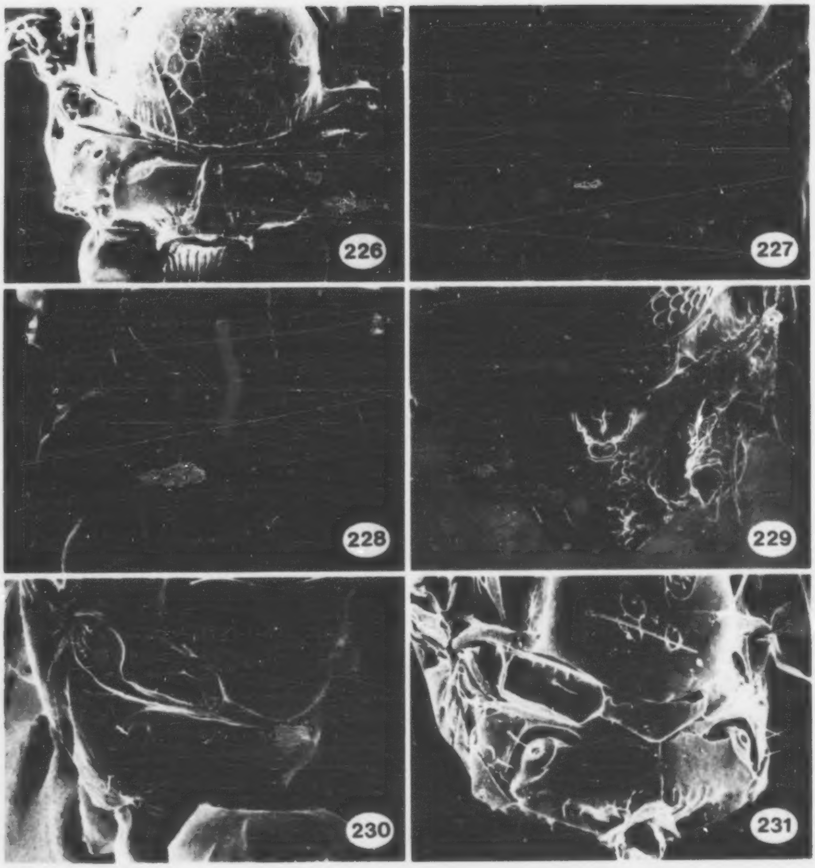
Figs. 220–225. Metanotum and propodeum: 220, ***Horismenus***; 221, ***Alachua***; 222, ***Pediobius***; 223, ***Entedon***; 224, ***Derostenus***; 225, ***Asecodes***.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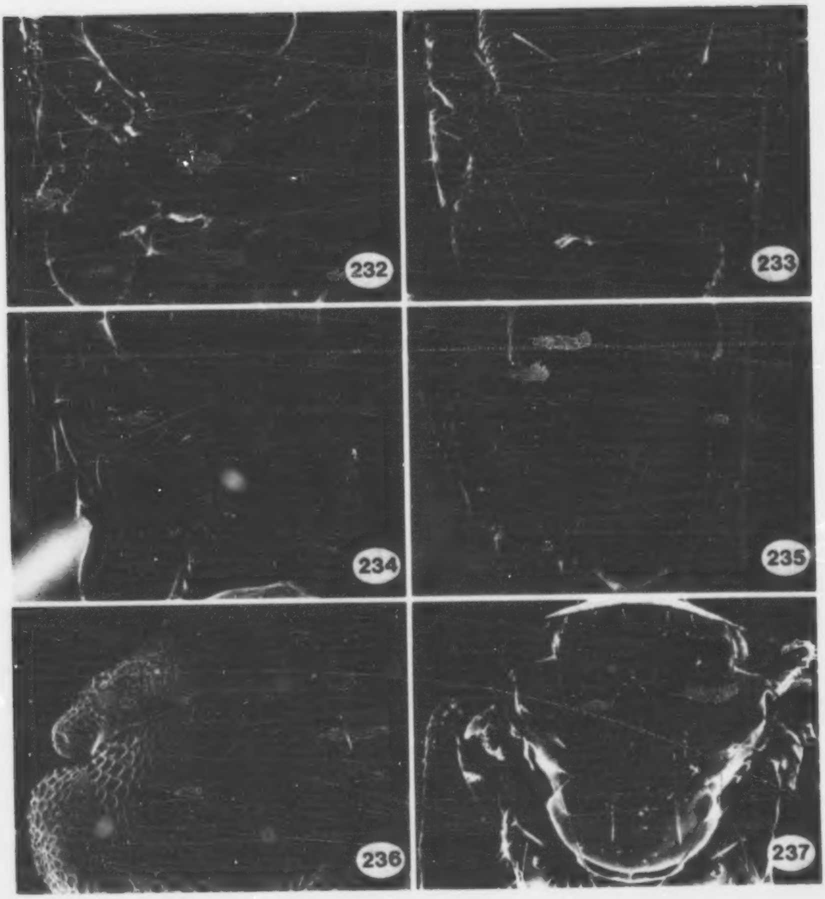
Figs. 226–231. Metanotum and propodeum: 226, ***Edovum***; 227, ***Emersonella***; 228, ***Paracrias***; 229, ***Mestocharis***; 230, ***Ceranisus***; 231, ***Achrysocharoides***.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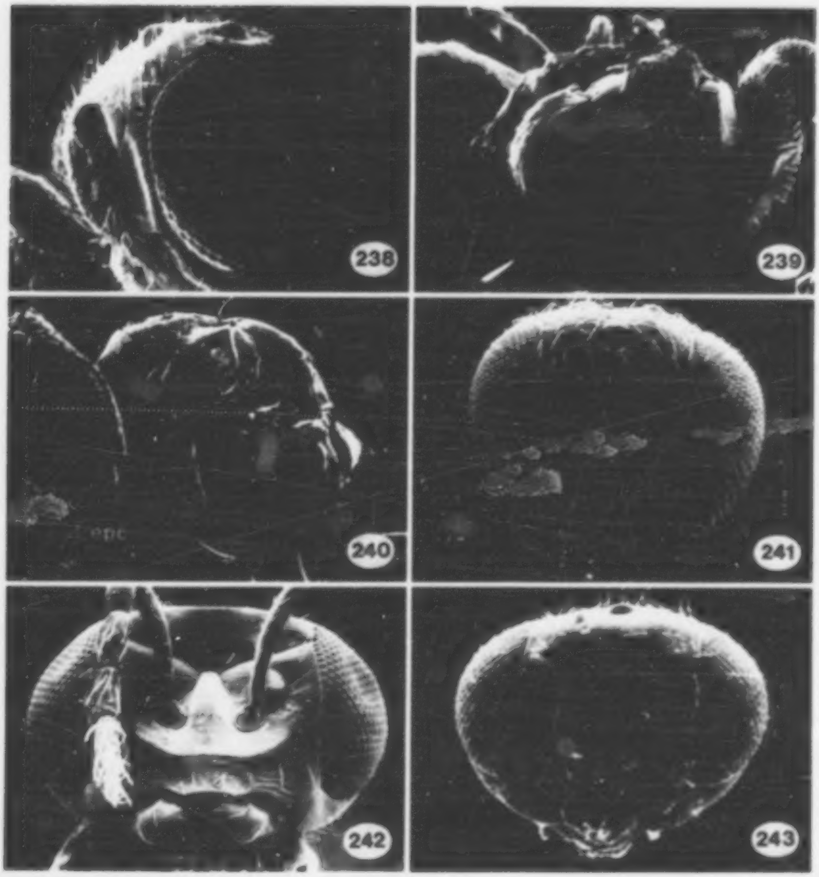
Figs. 232–237. 232–235, metanotum and propodeum: 232, ***Omphale***; 233, ***Closterocerus***; 234, ***Holcopelte***; 235, ***Chrysocharis***. 236, ***Entedon***, anterior mesosoma. 237, ***Alachua***, mesosoma.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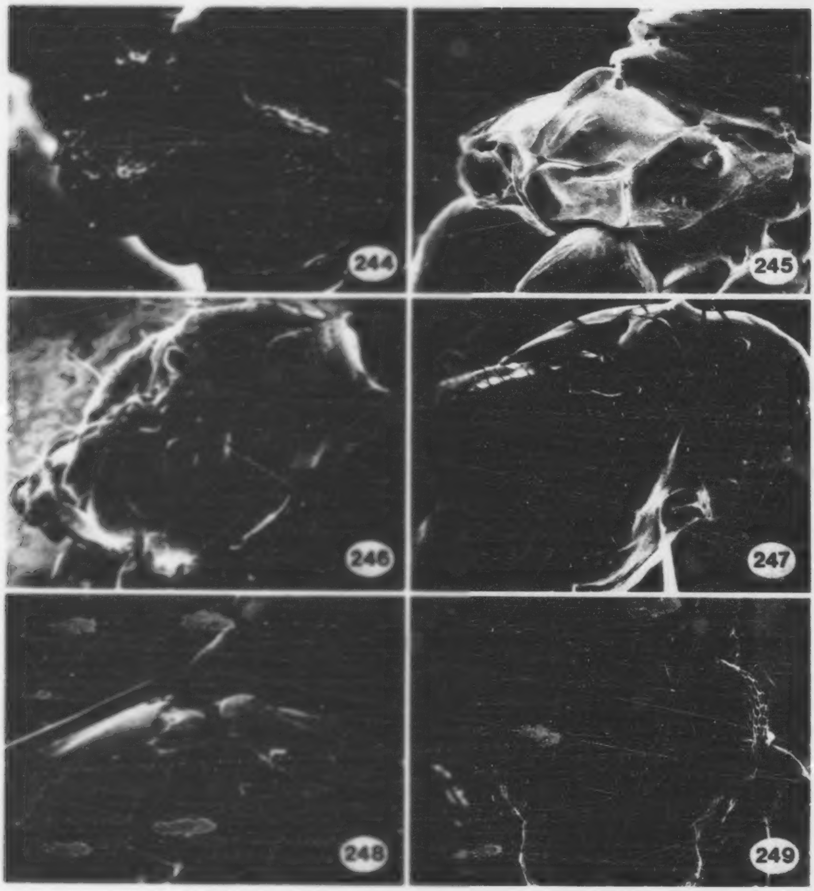
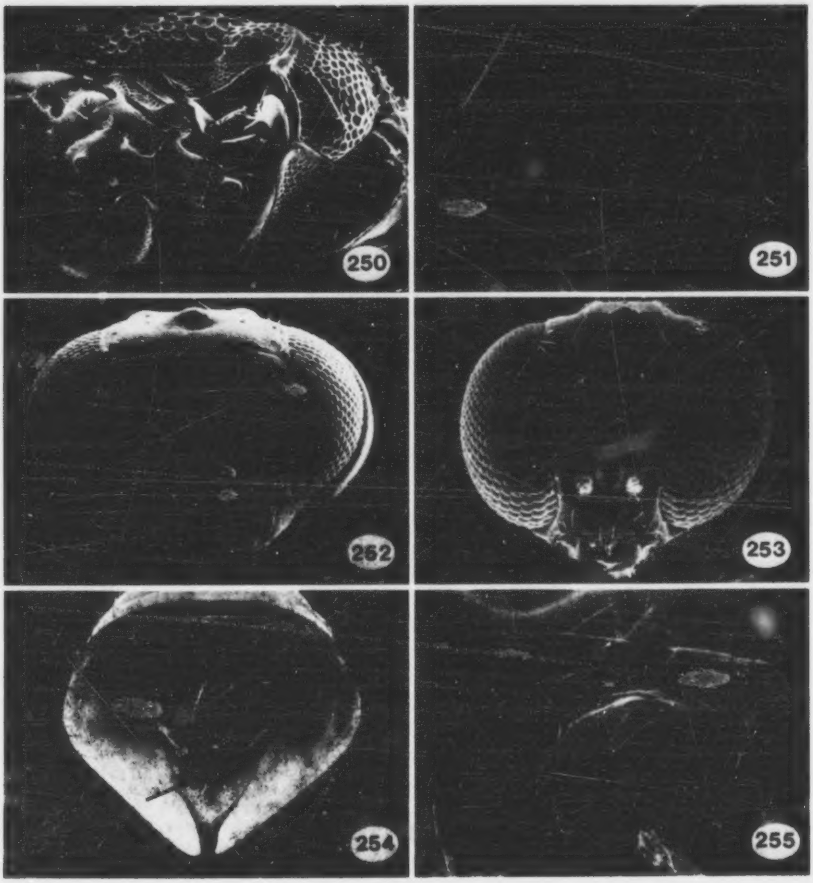
Figs. 238–243. 238, ***Alachua***, head. 239–241, ***Edovum***: 239, mesosoma; 240, mesosoma (lateral) (abbreviation: epc = epicnemial carina); 241, head. 242–243, head: 242, ***Omphale***; 243, ***Horismenus***.



Figs. 244–249. 244–245, propodeum (lateral): 244, ***Mestocharis***; 245, ***Pediobius***. 246–247, mesosoma: 246, ***Horismenus***; 247, ***Alachua***. 248–249, ***Horismenus***: 248, dorsellum and part of propodeum (lateral); 249, thorax.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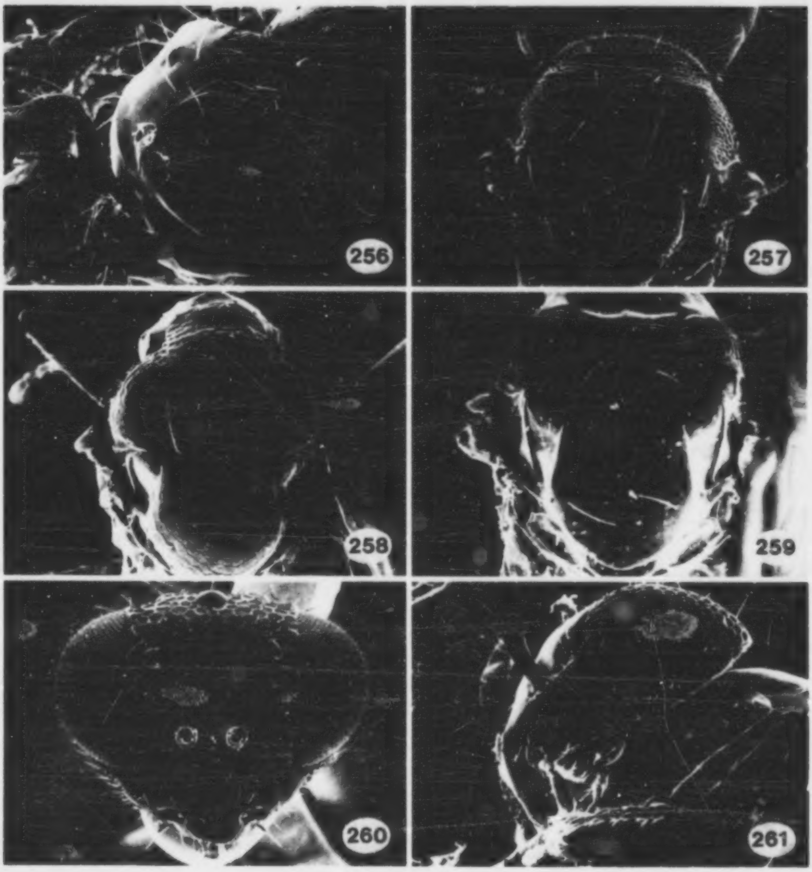
Figs. 250–255. 250–251, mesosoma: 250, ***Paracrias***; 251, ***Holcopelte***. 252–253, head: 252, ***Emersonella***; 253, ***Chrysocharis***. 254, ***Pediobius***, gaster (anterior). 255, ***Ceranisus***, head.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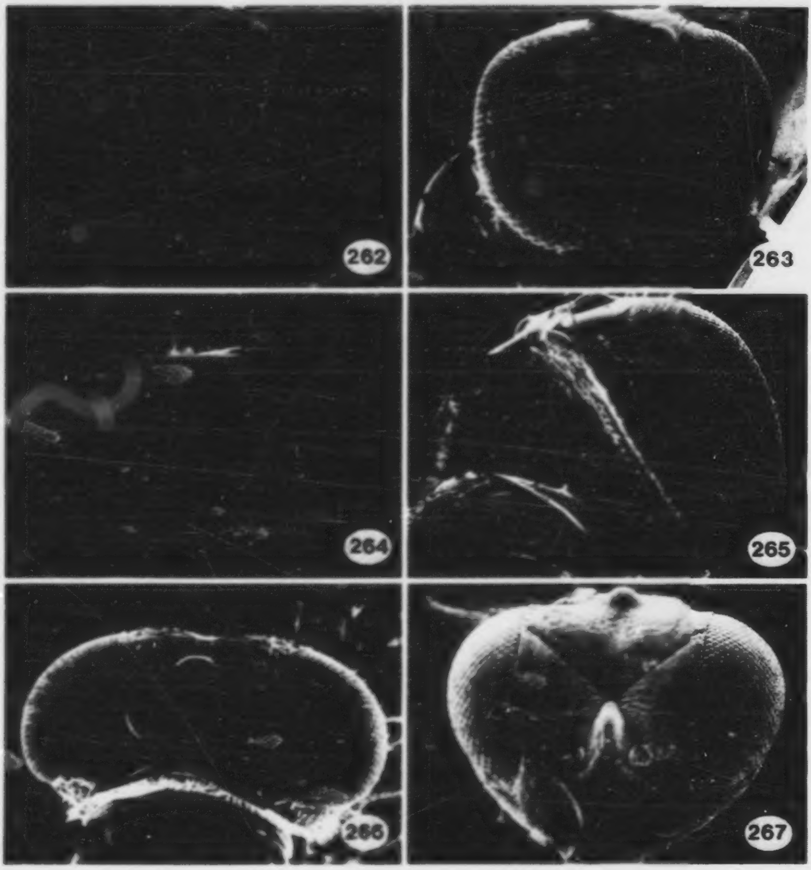
Figs. 256–261. 256, ***Thripobius***, head. 257–259, thorax: 257, ***Closterocerus***; 258, ***Holcopelte***; 259, ***Omphale***. 260, ***Entedon***, head. 261, ***Thripobius***, head.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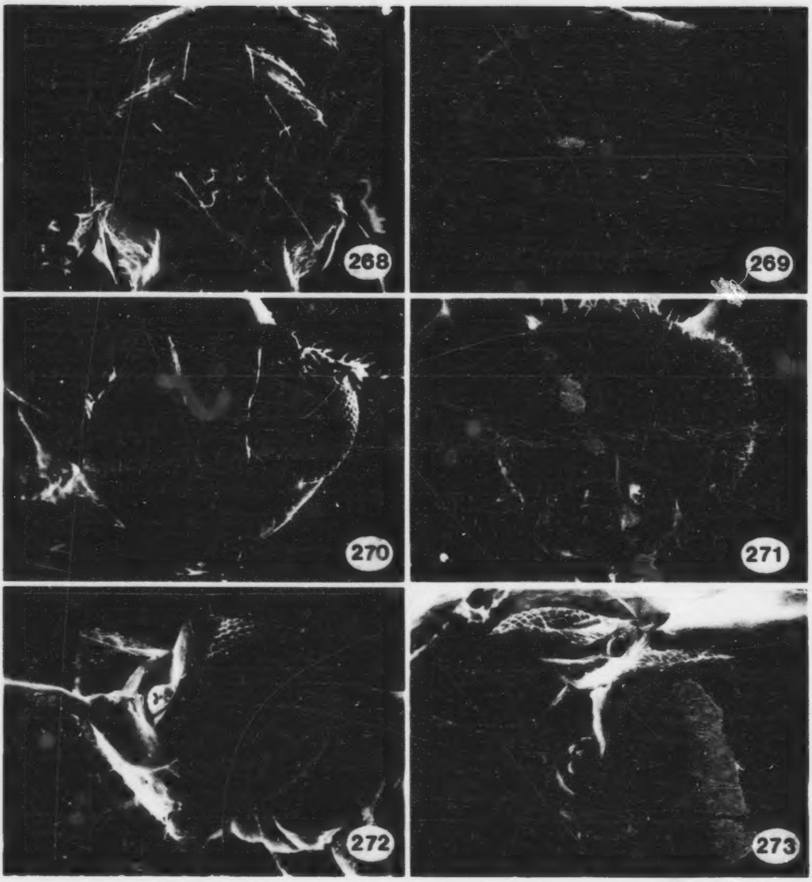
Figs. 262–267. 262, ***Asecodes***, thorax. 263–267, head: 263, ***Derostenus***; 264, ***Goetheana***; 265, ***Derostenus***; 266, ***Derostenus***; 267, ***Mestocharis***.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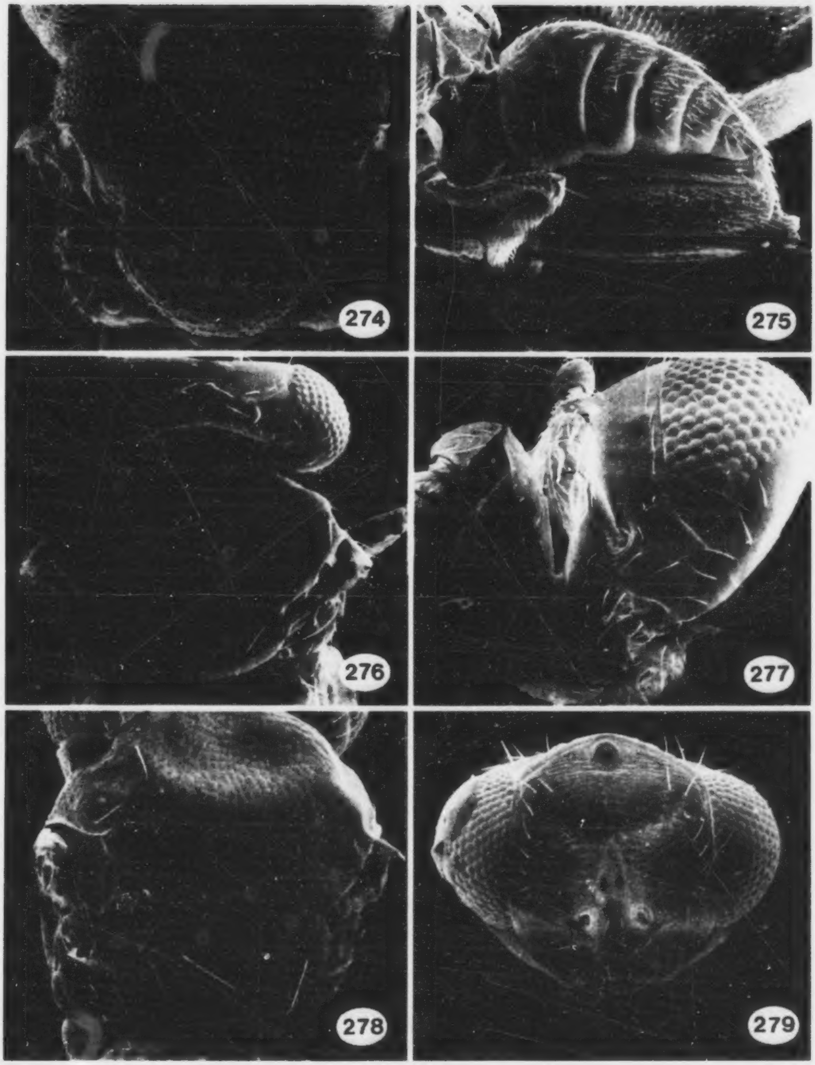
Figs. 268–273. 268, ***Achrysocharoides***, anterior mesosoma. 269–273, head: 269, ***Achrysocharoides***; 270, ***Asecodes***; 271, ***Closterocerus***; 272–273, ***Callifrons***.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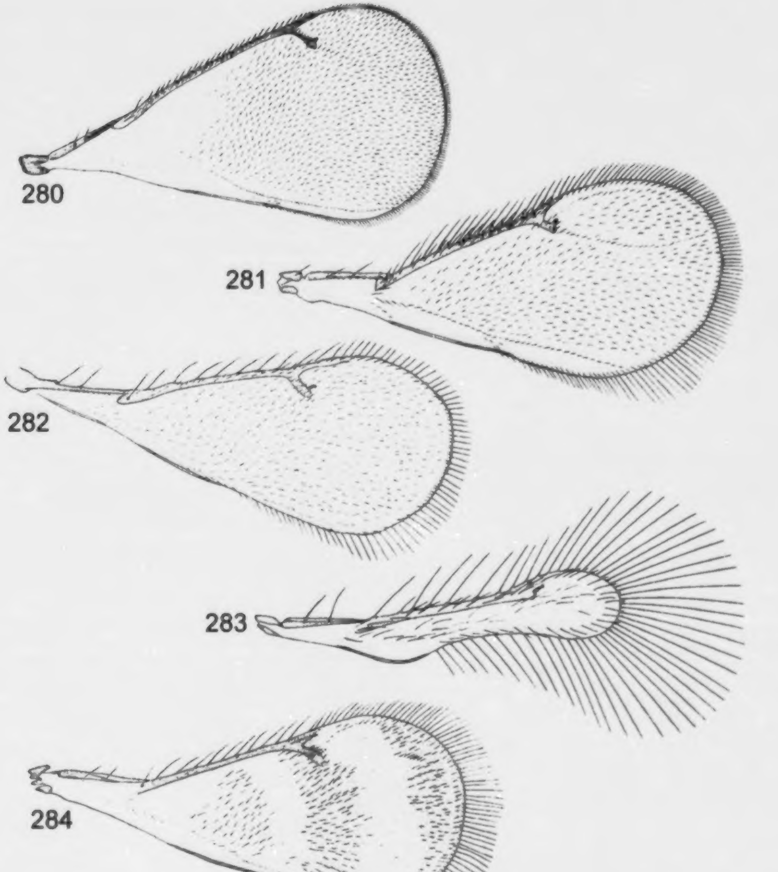
Figs. 274–279. 274, ***Aleuroctonus***, mesosoma. 275, ***Entedononecremnus***, gaster. 276–277, ***Euderomphale***: 276, head and mesosoma; 277, head. 278–279, ***Neopomphale***: 278, mesosoma; 279, head.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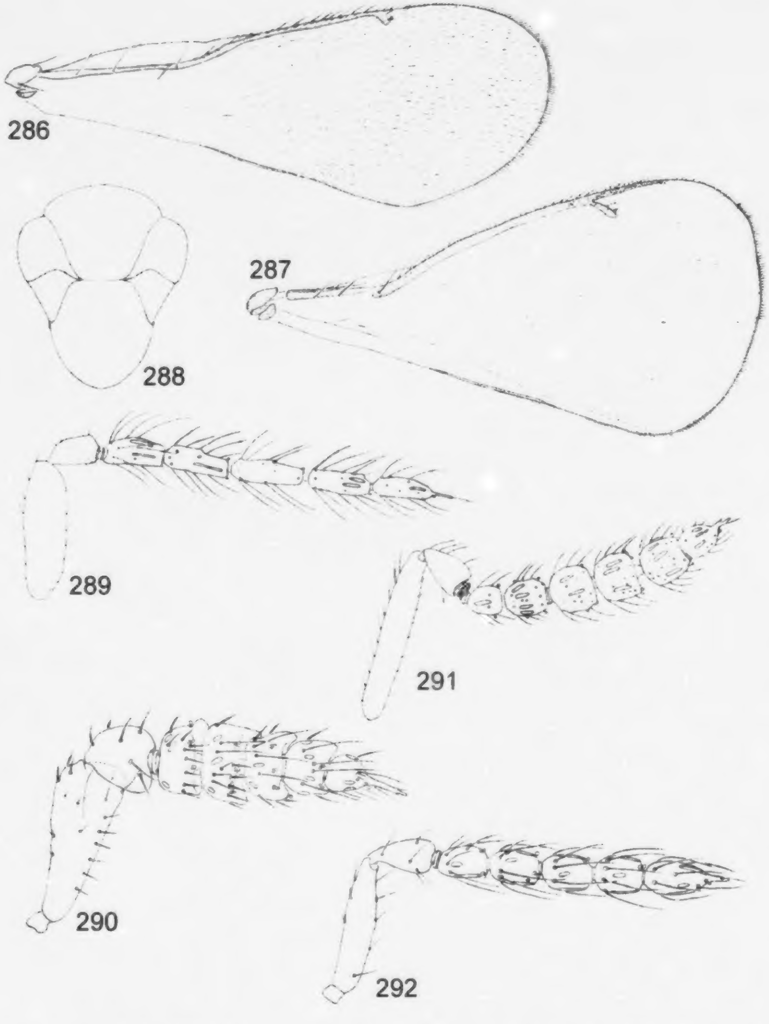
Figs. 280–285. Forewing: 280, ***Eprhopalotus***; 281, ***Teleopterus***; 282, ***Ceranisus***; 283, ***Goetheana***; 284, ***Closterocerus***; 285, ***Callifrons***.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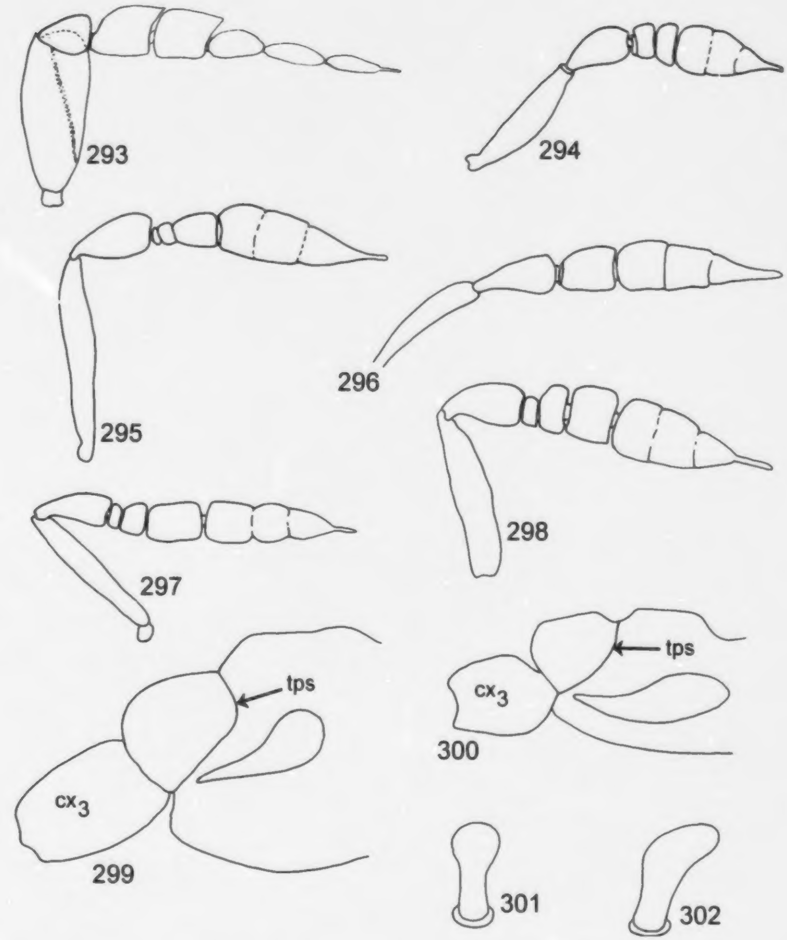
Figs. 286–292. 286–287, forewing: 286, ***Paracrias***; 287, ***Chrysocharis***. 288, ***Eprhopalotus***, mesonotum. 289–292, ♀ antenna: 289, ***Asecodes***; 290, ***Closterocerus***; 291, ***Derostenus***; 292, ***Emersonella***.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Figs. 293–302. 293–298, ♀ antenna: 293, ***Callifrons***; 294, ***Aleuroctonus***; 295, ***Euderomphale***; 296, ***Neopomphale***; 297–298, ***Entedononecremnus***. 299–300, thorax (lateral): 299, ***Neochrysocharis***; 300, ***Closterocerus***. 301–302, capitate peg sensilla of flagellum: 301, ***Closterocerus***; 302, ***Neochrysocharis***.

Chapter 11. **EUPELMIDAE**

Gary A. P. Gibson

Recognition/Systematics. Eupelmidae does not have any autapomorphic features that distinguish its members from other families. The family cannot be diagnosed without including some members that do not have one or more of its diagnostic features and without excluding some taxa that have one or more of the features. Some features shared by all eupelmids are derived, but are also shared with some other chalcidoids: mesotibial spur comparatively long, and usually relatively thick and microsetose (Figs. 138–148); eyes with inner margins diverging, at least ventrally (Figs. 1, 2, 95–109); and protibia with its dorsoapical margin having 1 or more small, curved spicules (Fig. 137). Many other features that have been used to characterize Eupelmidae are primitive and consequently are shared with many other chalcidoids: tarsi 5-segmented; forewing with marginal vein relatively long (Figs. 149–163); mesocoxa conspicuously posterior to midline of mesopleuron, adjacent to metacoxa and distant from procoxa (Figs. 7, 8); and cerci near apex of metasoma. Finally, other conspicuous features are not only shared with some other chalcidoids but are not possessed by some eupelmids: acropleuron varied, from small and flat (Fig. 12) to large, convex, and extending to or near to metapleuron (Figs. 7–9); mesothoracic venter with or without membranous region anterior to each mesocoxa (cf. Figs. 3–6); mesocoxae able or unable to rotate anteriorly out of combined fossae (cf. Figs. 7–10); mesotibia with or without apical pegs (cf. Figs. 138–148); and mesotarsus with or without one or more ventral rows of pegs (cf. Figs. 138–148). Gibson (1989) interpreted the above character-state distributions to indicate that Eupelmidae likely represents a grade-level taxon that is not monophyletic.

The family Eupelmidae is composed of three subfamilies, Eupelminae Walker, Calosotinae Bouček, and Neanastatinae Kalina. Males and females are similar in structure in both Calosotinae and Neanastatinae, but extreme sexual dimorphism characterizes Eupelminae (Gibson 1986, 1989). Female eupelmines possess all of the derived features of the family but male eupelmines lack the last group of derived features listed above and look much like many pteromalids, particularly Cleonyminae. This either-or structure of Eupelminae contrasts with Calosotinae, in which structure varies from a more or less pteromalid-like appearance (individuals of *Archaeopelma*, Figs. 5, 11, 12, 139) to highly modified forms that resemble female eupelmines.

Within the Nearctic region, male Eupelminae are distinguished from all Pteromalidae except Cleonyminae by the following features: flagellum with 7 or 8 visible segments between the pedicel and clava, including at most 1 anellus (Figs. 113–128); eyes with inner margins diverging ventrally (Figs. 95–109); mesotibial spur subequal in length to basitarsus and about one-third as long as tarsus (Fig. 138); and protibia with 1 or more dorsoapical spicules (requires careful observation) (Fig. 137). With experience, eupelmine and cleonymine males can be differentiated using a combination of external features. However, the only absolute feature to distinguish males of the two groups requires removal of a middle leg. Male cleonymines have the two mesocoxal foramina separated by cuticle (Fig. 129), whereas the foramina are broadly joined by membrane in male eupelmines (Fig. 130).

Gibson (1986) described eupelmine sexual dimorphism and explained structural differences between the sexes based on functional differences. Most chalcidoids use their middle legs to jump. Male eupelmines retain the primitive method and musculature for jumping and retain a correspondingly primitive structure. Females, however, evolved a highly modified jumping mechanism for much quicker and more powerful jumps, which includes a highly modified musculature and external structure (Gibson 1986, 1989, 1995*a*, *b*).

Biology. Eupelmidae are ectoparasites of the larvae or prepupae of insects usually concealed in plant tissue or cocoons, or are endoparasites or predators of insect or spider eggs. Most Calosotinae parasitize wood-inhabiting Coleoptera, though some species of *Calosota* are primary or secondary parasites of insects in grass stems and others have been reared from the nests of solitary wasps and bees (Hymenoptera). Within Neanastatinae, species of *Metapelma* are parasites of wood-inhabiting Coleoptera, but *Lambdobregma schwarzii* (Ashmead) is an endoparasite of eggs of crickets (Grylloidea). The host range of Eupelminae is much more diverse, including the eggs of spiders (Araneae) and the immature stages of Orthoptera, Blattaria, Mantodea, Hemiptera, Homoptera, Neuroptera, Coleoptera, Diptera, Lepidoptera, and Hymenoptera. One species of *Calymmochilus* Masi from Australia has also been reared from the chrysalides of a pseudoscorpion (Pseudoscorpiones: Garypidae). Eupelmine hosts occur in a wide variety of situations, either exposed or concealed in plant tissue, aculeate nests, galls or various forms of sacs and cocoons. Many species are known to be polyphagous, apparently accepting diverse hosts of similar physical appearance in a particular ecological niche. At least one species, *Eupelmus australiensis* (Girault), can even complete development on plant tissue if at least one sorghum midge (Cecidomyiidae) larva or pupa has been consumed (Woodruff 1929). Larvae are also known to be voracious, acting as parasites if a single host is available, but usually as predators if more than one host is available. Hyperparasitism is common and almost always the eupelmine is the successful competitor if a primary host is parasitized by more than one parasite species (Gibson 1995*a*). Gibson (1995*b*) postulated that these biological attributes evolved, at least in part, as a consequence of the reduced flight ability of females.

Within the Nearctic region, species of two of the most common genera, *Brasema* and *Eupelmus*, are ectoparasites of insect larvae or pupae, whereas species of another common genus, *Anastatus*, are almost always endoparasites of insect eggs. Most species of *Arachnophaga* either parasitize cocoons of Lepidoptera or are predators of spider eggs in silk sacs, and species of *Lecaniobius* are predators of scale insect eggs (Coccoidea). Accurate host ranges are not known for other eupelmine genera in the Nearctic region, but at least one species of *Ooderella*, *Oozetetes*, and *Zaischnopsis* have been reared from insect eggs, at least one species of *Reikosiella* and *Tineobiopsis* have been reared as ectoparasites of Lepidoptera larvae or pupae, and one species of *Phlebopenes* has been reared from Sphecidae.

Fauna. Approximately 850 species of Eupelmidae are classified in 45 genera (Gibson 1995*a*). Within the Nearctic region, 110 species are recognized in 21 genera: three species in two genera of Neanastatinae, 19 species in five genera of Calosotinae, and 86 species in 14 genera of Eupelminae. However, most Nearctic genera require revision, which will greatly change these numbers. For example, of the 38 species classified in *Eupelmus* by Burks (1979), 20 species belong to *Brasema*, three species belong to *Reikosiella*, and one species belongs to *Anastatus*. Though Eupelminae is the most diverse subfamily, much of its generic diversity appears to result from peripheral distribution of genera centered in the Neotropical region. Of the 14 genera represented in the Nearctic region, all occur in the Neotropical region and half are known only from the southern United States or from a single species in the region.

Literature. Bouček (1988) established the subfamily name Metapelmatinae, but this is a junior synonym of Neanastatinae Kalina (1984) (Gibson 1993). Gibson (1989, 1995*a*) revised the world genera of Calosotinae and Neanastatinae, and the world genera of Eupelminae, respectively, diagnosed the family and the three subfamilies (Gibson 1989, 1993), and summarized biological attributes of the family (Gibson 1995*b*).

Use of key. The following key treats only the genera occurring in the Nearctic region north of Mexico. Males are unknown for the following genera of Eupelminae: *Ooderella*, *Oozetetes*, *Tineobiopsis*, and *Uropelma*.

The key includes some specialized terminology that is not used in other chalcidoid families. The propodeum of female eupelmines is subdivided into a median **plical region** and lateral **callar regions** by a change of sculpture, convexity, and/or by a distinct furrow mesal to each spiracle (Figs. 71, 72). The plical region sometimes has an anteromedial **plical depression** behind or under the scutellar apex (Figs. 55, 56, 62). Some female eupelmines have the posteromedial margin of the syntergum subcircularly emarginate and surrounding a variedly melanized and sclerotized **anal sclerite** that covers the anus.

Key to genera and subgenera of Eupelmidae

1 *Both sexes*: acropleuron almost always convex and forming most (Figs. 7, 18) or all (Figs. 8, 9) of mesopleuron, but if very rarely slightly concave and forming only about anterior two-thirds of mesopleuron then acropleuron broadening posteriorly nearly to mesothoracic venter (Fig. 12) 2

– *Male*: acropleuron small and subrectangular, sometimes extending to base of hind wing, but conspicuously separated from mesothoracic venter (Figs. 131–133) .... EUPELMINAE, 33

2(1) Mesothoracic venter without membranous area anterior to each mesocoxa and mesocoxae never directed anteriorly (Figs. 3, 4, 7, 8); mesotarsus with 1 row of pegs along anteroventral margin, the pegs also extending along apical margin of basal 3 tarsal segments (Fig. 140) .... NEANASTATINAE, 3

– Mesothoracic venter with at least small membranous area anterior to each mesocoxa (Figs. 5, 6) or with areas concealed (Fig. 10) if coxae rotated anteriorly out of fossa (Figs. 9, 10); mesotarsus either without pegs (Fig. 139), or with pegs along posteroventral margin (Fig. 141), or along both margins (142, 146–148), or pegs reduced in number but then tarsal segments densely setose ventrally (Figs. 144, 145) 4

3(2) Head in lateral view with distinct frontovertex and with ∧ -shaped scrobes on face (Fig. 1); acropleuron extending to metacoxa (Fig. 8) .... ***Lambdobregma*** Gibson

Fauna: 1 sp., *L. schwarzii* (Ashmead), in USA (southern FL). **Hosts**: cricket eggs (Grylloidea).

– Head lenticular and with small, shallow, inconspicuous scrobe above each torulus (Fig. 2); acropleuron separated from metacoxa by mesepimeron and metapleuron (Fig. 7) .... ***Metapelma*** Westwood

Fauna: 2 nominal spp., widespread. **Hosts**: larvae of wood-boring Coleoptera.

4(2) Fully winged; mesoscutum distinctly shoulder-like posterior to pronotum and evenly convex, with ∨-like or subparallel, linear notauli (Figs. 11, 15–17, 19, 20); pronotum entire (Figs. 11, 15–17, 19) .... CALOSOTINAE, 5

– Fully winged or short winged, but if fully winged then mesoscutum not distinctly shoulder-like posterior to pronotum and with deep, ∨-like notauli and posteromedial depression distinguishing anteromedian and lateral mesoscutal lobes (Figs. 41, 42, 47–50); pronotum usually divided or with median white line (Figs. 41–46) .... EUPELMINAE, 9

5(4) Scutellum pointed anteriorly and axillae contiguous (Fig. 11); acropleuron flat or slightly concave, and broadly separated from mesocoxa and metacoxa (Fig. 12) .... ***Archaeopelma*** Gibson

Fauna: 1 sp., *A. tropeotergum* Gibson (1989), in USA (AZ, TX). **Hosts**: likely larvae of wood-boring Coleoptera.

– Scutellum truncate anteriorly (Figs. 13, 15–17, 19) and axillae narrowly (Fig. 16) to very broadly (Figs. 13, 19) separated; acropleuron convex and at most only narrowly separated from mesocoxa and metacoxa (Fig. 18) 6

6(5) Scutoscutellar sutures concave, hence scutellum with petiolate base (Figs. 15, 16); mesotarsus ventrally with row of spines or pegs along posterior margin more robust than along anterior margin (Fig. 141); flagellum filiform, microsetose, and at least females with apical segment (clava) at most as long as penultimate segment (Figs. 21, 22) .... ***Eusandalum*** Ratzeburg

Key: Girault (1917). **Fauna**: 11 nominal and several undescribed spp., widespread. **Hosts**: larvae of wood-boring Coleoptera.

– Scutoscutellar sutures straight, hence scutellum quadrate or tapered to base (Figs. 13, 17, 19); mesotarsus ventrally with equally developed row of spines or pegs along posterior and anterior margins (Fig. 142); flagellum usually branched or clavate with clava conspicuously larger than penultimate segment (cf. Figs. 116–119), but if rarely filiform (males only) then with conspicuous decumbent setae (cf. Figs. 125, 126) 7

7(6) Mesothorax with apex of prepectus widely separate from tegula (Fig. 14); mesoscutum umbilicately punctured (Fig. 13) .... ***Balcha*** Walker

Fauna: 1 unidentified sp. accidentally introduced into USA (VA) [new record]. **Hosts**: unknown, but extralimital species on larvae of Buprestidae and likely other wood-boring Coleoptera.

– Mesothorax with prepectus and tegula contiguous (Fig. 20) unless prepectus reflexed over mesopleuron when mesonotum arched (Fig. 18); mesoscutum punctate-reticulate (Figs. 17–20) 8

8(7) Forewing with very short postmarginal and stigmal veins, the stigmal vein peg-like (Fig. 149); notauli ∨-shaped (Fig. 17); acropleuron separated from metapleuron by subrectangular mesepimeron (Fig. 18) .... ***Licrooides*** Gibson

Fauna: 1 sp., *L. umbilicatus* Gibson (1989), in southern USA. **Hosts**: unknown, but likely larvae of wood-boring Coleoptera.

– Forewing with normal postmarginal and stigmal veins, the stigmal vein with uncus (cf. Figs. 150–153); notauli subparallel (Fig. 20); acropleuron contiguous with metapleuron, at least dorsally (Fig. 20) .... ***Calosota*** Curtis

Key: Burks (1973). **Fauna**: 5 nominal and several undescribed spp. **Hosts**: mostly larvae of wood-boring Coleoptera, but *C. metallica* (Gahan) is a primary or secondary parasite of insects mining grass stems.

9(4) Metasoma with posterior margin of syntergum deeply, subcircularly emarginate (Figs. 77–82), the emargination often surrounding a sclerotized, horizontal to vertical anal sclerite (Figs. 77, 78); mesotibia without apical groove between tibial spur and base of tarsus and either without apical pegs or, if present, pegs at least partly over base of tarsus (Figs. 144 –148) 10

– Metasoma with posterior margin of syntergum truncate (Figs. 83–88) or variously differentiated into a rim or fingernail-like flange (Figs. 89–93); mesotibia almost always with apical groove between tibial spur and base of tarsus, and with apical pegs restricted to narrow region over base of spur (Fig. 143) 18

10(9) Head with gena produced as acutely angled vertical lobe adjacent to base of mandible, the mouth margin in anterior view broadly incurved (Fig. 23); mandible with small ventroapical tooth and obliquely angled dorsoapical margin (Fig. 24) .... ***Ecnomocephala*** Gibson

Fauna: 1 sp., *E. townesi* Gibson (1995*a*), in USA (FL).

– Head with gena not produced, the mouth margin in anterior view straight transverse or slightly convex (Figs. 25–40); mandible with 3 teeth (Figs. 32, 35) 11

11(10) Metasoma with Mt_7 (penultimate tergum, bearing spiracle) medially divided or with median hyaline line **and** largely or entirely concealed under Mt_6 (Mt_6 extending posterior to spiracles) (Figs. 77–79); forewing of fully winged individual almost always with linea calva (Fig. 150) .... ***Eupelmus*** Dalman, 12

Fauna: numerous spp. (see under subgenera), widespread. **Hosts**: usually larval or pupal, primary or secondary parasites of a wide variety of holometabolous insects usually concealed in protected situations, such as in cocoons, galls, or other plant tissue.

– Metasoma with Mt_7 entire and not concealed under Mt_6 (Figs. 80–82); forewing of fully winged individual without linea calva (Fig. 151) 14

12(11) Fully winged; mesotarsal pegs white to reddish and aligned in straight row along each ventrolateral margin of basitarsus (Fig. 144); mesotibia at most with light colored spines apically (Fig. 144); metanotum ∨ - or ∪ -shape protuberant into plical depression of propodeum (Figs. 53, 54)...... ***Eupelmus*** (***Episolindelia*** Girault)

Fauna/Hosts: 1 introduced sp., *E. australiensis* (Girault), on *Contarinia sorghicola* (Coquillett) and other Cecidomyiidae in grasses, and a few rare undescribed species in USA.

– Short winged or, if fully winged, mesotarsal pegs different, with pegs sometimes reduced or absent (then basitarsus densely setose ventrally, Fig. 145), but if forming complete rows then pegs black and almost always segregated into 2 partial rows on basitarsus (Fig. 146); mesotibia usually with row of black pegs apically (Figs. 145, 146); metanotum with posterior margin almost straight (Figs. 55–58) and propodeum often with ∨ - or ∪ -shaped plical depression (Figs. 55, 56) 13

13(12) Short winged; pronotal collar with distinct transverse ridge (Fig. 45); metanotum relatively large and flat, though more or less concave posterior to apex of scutellum (Figs. 57, 58); propodeum at most with flattened, inconspicuous, ∨ -shaped plical area (Figs. 57, 58) .... ***Eupelmus*** (***Macroneura*** Walker)

Key: Gibson (1990). **Fauna**: 7 spp., widespread.

– Fully winged or rarely short winged; pronotal collar without ridge; metanotum transverse and with dorsellum convex and appressed over apex of scutellum (Fig. 55); propodeum with conspicuous ∨ - or ∪ -shaped plical depression (Figs. 55, 56)......................... .... ***E.*** (***Eupelmus*** Dalman)

Fauna: 14 nominal spp., widespread.

14(11) Body about 10 mm long excluding very long ovipositor sheaths, the sheaths conspicuously longer than body; head and mesosoma bright metallic green, and metasoma yellowish orange; forewing not distinctively long and narrow, with marginal vein shorter than breadth of wing .... ***Phlebopenes*** Perty

Key: Roman (1917) (world species). **Fauna**: 1 sp., *P. abdominalis* Ashmead, in USA (AZ). **Hosts**: unknown; 1 extralimital sp. reared from nest of *Trypoxylon* (Sphecidae), but most species likely on larvae of wood-boring Coleoptera.

– Body at most about 5 mm long and if with very long ovipositor sheaths then body yellowish to brown; forewing distinctively long and narrow, with marginal vein at least as long as, and usually distinctly longer than, breadth of wing (Fig. 151)............................ .... ***Reikosiella*** Yoshimoto, 15

Fauna: several spp. (see under subgenera). **Hosts**: unknown, but 1 extralimital sp. reared from larvae of Alucitidae.

15(14) Dorsellum a broad, flat, ∪ - or ∨ -like band contiguous with scutellum and propodeum, the three structures forming continuous cohesive complex (Figs. 59, 60); syntergum with posterior margin at most only obscurely emarginate .... ***Reikosiella*** (***Incohata*** Gibson) (part)

Fauna: 1 sp., *R. guttata* Gibson (1995*a*), in USA (AZ).

– Dorsellum either flat under apex of scutellum (Figs. 61, 62) or reflexed over apex of scutellum, sometimes as vertical flange (Figs. 63–66) (scutellum in lateral view often protuberant, Figs. 61, 65); syntergum with posterior margin distinctly emarginate (Figs. 80, 81) 16

16(15) Propodeum with transverse or anteriorly curved carina or keel delineating anterior depression from posterior furrow or sloping surface (Fig. 62); dorsellum slender medially and overlain by apex of scutellum (Fig. 61) .... ***R.*** (***Reikosiella***) Yoshimoto

Fauna: 3 described spp. [classified in *Eupelmus* by Burks (1979)] and several undescribed spp., in southern Canada and in USA.

– Propodeum without transverse carina differentiating anterior and posterior surfaces, though sometimes with anteromedial depression (Fig. 64) and with median carina if propodeum relatively long (Fig. 66); dorsellum a flat flange under apex of scutellum (Figs. 65, 66) or reflexed over apex of scutellum (Figs. 63, 64) 17

17(16) Flagellum conspicuously bicolored, with 1 or more funicular segments white; ovipositor sheaths shorter than metasoma; mesotibia with apical pegs (Fig. 148), though pegs light-colored and often difficult to discern .... ***Reikosiella*** (***Hirticauda*** Bouček)

Fauna: at least 2 undescribed spp., in southern Canada and in USA.

– Flagellum unicolored; ovipositor sheaths longer than metasoma, usually conspicuously so; mesotibia without apical pegs .... ***Reikosiella*** (***Capreocauda*** Gibson)

Fauna: at least 3 undescribed spp., in Canada (BC) and USA.

18(9) Mesosoma with scutellum, metanotum, and propodeum forming continuous cohesive complex in low convex plane, with dorsellum a relatively broad, flat, ∪ - or ∨ -like band (Figs. 59, 60); mesotibia without apical groove and if with apical pegs then pegs over base of tarsus (Fig. 147) .... ***Reikosiella*** (***Incohata***), see 15

– Mesosoma with complex composed of scutellum, metanotum, and propodeum different, highly varied; mesotibia with apical groove between tibial spur and base of tarsus and with apical pegs over base of spur (Fig. 143) 19

19(18) Head in lateral view relatively flat with torulus distinctly below level of lower margin of eye **and** with rounded or carinate ridge along oblique line between torulus and lower margin of eye (Figs. 29–32); syntergum with posterior margin distinctly reflexed as fingernail-like flange **and** with median length of sclerite anterior to flange at most equal to length of flange (Figs. 90, 91) (syntergum sometimes partly or entirely concealed if telescoped under Mt_7 or Mt_{6+7}) .... ***Arachnophaga*** Ashmead, 20

Fauna: several spp. (see under subgenera). **Hosts**: usually predators of spider eggs (Araneae) or primary and secondary parasites of Lepidoptera pupae, though 2 spp. recorded as parasites of Chrysopidae.

– Head in lateral view often ovoid to subglobose (Figs. 26, 36), but if relatively flat then with torulus approximately in line with lower margin of eye or at least without evident change of curvature along line between torulus and lower margin of eye (Figs. 28, 34); syntergum with posterior margin not reflexed (Figs. 83–88) or, if reflexed as flange, then median length of sclerite anterior to flange often distinctly greater than length of flange (Fig. 92) 23

20(19) Torulus very close to mouth margin, separated by vertical region below torulus at most about as long as width of torulus (Figs. 31, 32); forewing with bare area behind base of marginal vein, though area sometimes very small if wing reduced (Fig. 157) .... ***Arachnophaga*** (***Shedocremna*** Gibson)

Fauna: 1 sp., *A. eucnemia* Gibson (1995*a*), in southern Canada and in USA, and 1 undescribed sp. in USA (FL).

– Torulus and mouth margin separated by distance about as great as distance between toruli (Fig. 29) and region below torulus in similar plane as face (Fig. 30); fully winged specimen with forewing evenly setose behind marginal vein (Figs. 154–156)............... 21

21(20) Propodeal foramen sinuately ∧ -shaped, acutely angled medially (Fig. 51); forewing with costal cell dorsoapically broad and bare (though with row of long setae on ventral surface apically, Fig. 154) .... ***A.* (*Arachnophaga*)** Ashmead

Key: Gahan (1943) [couplets 8–13 (females) and 15, 18, 19 (males)]. **Fauna**: 6 spp., in southern Canada and in USA.

– Propodeal foramen relatively broadly ∩ -shaped (Figs. 48, 52); forewing with costal cell dorsoapically narrow and densely setose (Figs. 155, 156) 22

22(21) Metatibia dark; scutellum relatively flat or low convex and with scattered though often bristle-like setae (Figs. 47, 48) .... ***Arachnophaga* (*Brasemopsis*** Brèthes)

Key: Gahan (1943) [couplets 2–8 (females) and 17 (males)]. **Fauna**: 4 spp. in USA.

– Metatibia with dorsal margin white; scutellum conspicuously convex above plane of axillae and with median or anteromedian tuft of erect black setae (Figs. 49, 50) (setae sometimes missing from mounted specimens) .... ***Arachnophaga* (*Idoleupelmus*** Ashmead)

Key: Gahan (1943) (as *Encyrtaspis*). **Fauna**: 3 spp. in USA.

23(19) Short winged, the forewing usually extending at most about half length of metasoma, but at least conspicuously shortened and sometimes bent at right-angle at apex of mesosoma (Figs. 45, 67, 69) 24

– Fully winged, the forewing flat and extending at least three-quarters length of metasoma 28

24(23) Ovipositor sheaths conspicuously projecting and compressed-spatulate (Fig. 94); mesosoma (Figs. 43, 44) with broad dorsal and usually lateral longitudinal yellowish band .... ***Uropelma*** Sharkov

Fauna: 1 sp., *U. formosum* Sharkov (1988), in USA (CA, FL).

– Ovipositor sheaths not projecting or, if so, not compressed; mesosoma not longitudinally banded 25

25(24) Propodeum large, convex, and with median carina (Figs. 67, 68); acropleuron with conical tuft of white setae near anterodorsal margin (Fig. 46); pronotum with flat, quadrate collar having carinately right-angled anterolateral corners (Fig. 44) .... ***Ooderella*** Ashmead

Fauna: 1 undescribed sp. in USA (IL, PA) [records anomalous because genus otherwise restricted to Central and South America]. **Hosts**: eggs of *Orchelimum* (Tettigoniidae).

– Propodeum linear or strongly transverse medially (foramen ∩ - or ∧ -like incurved) (Figs. 69–76); acropleuron bare or evenly setose anteriorly; pronotum without distinct collar 26

26(25) Head with distance between posterior ocellus and eye margin subequal to distance between posterior ocelli, and about 3 times diameter of ocellus (Fig. 27); metatibia conspicuously compressed; head flat-lenticular, in anterior view with toruli very close to mouth margin and with large and conspicuously setose eyes (Figs. 27, 28) .... ***Psomizopelma*** Gibson

Fauna: 1 sp., *P. brachypterum* Gibson (1995*a*), in USA (southern FL).

– Head with distance between posterior ocellus and eye margin only about half distance between posterior ocelli, and at most about 2 times diameter of ocellus; metatibia not conspicuously compressed or, at most, compressed to a carinate dorsal margin in basal half; head with anterior surface more distinctly convex or with toruli further from mouth margin and with eyes smaller (Figs. 25, 26, 33, 34, 38) 27

27(26) Metasoma in dorsal or posterodorsal view with posterior margin of syntergum truncate to slightly emarginate (Figs. 83, 84, 86); metasoma uniformly colored; mandible with 3 teeth (cf. Fig. 35) .... ***Brasema*** Cameron, see 32

– Metasoma with posterior margin of syntergum at least obscurely reflexed as linear rim or more conspicuous fingernail-like flange (Figs. 90–92); metasoma basally partly white, at least ventrally and often dorsally (white area obscure if metasoma yellowish); mandible with single ventroapical tooth and broad dorsoapical margin (cf. Fig. 37) .... ***Anastatus*** Motschulsky, see 31

28(23) Metatibia conspicuously compressed, with carinate dorsal margin ... .29

– Metatibia at most moderately compressed, with rounded dorsal margin 30

29(28) Ovipositor sheaths projecting for distance at least equal to length of metasoma; head with very shallow scrobes not extending to anterior ocellus (Fig. 38) .... ***Tineobiopsis*** Gibson

Fauna: 1 undescribed sp. in USA (AZ). **Hosts**: 1 Mexican sp. recorded on larvae of Incurvariidae and Prodoxidae associated with *Yucca*.

– Ovipositor sheaths projecting only slightly beyond apex of metasoma; head with deep scrobes, each having carinate margin extending from lower inner margin of eye to anterior ocellus (Figs. 39, 40) .... ***Lecaniobius*** Ashmead

Key: Compere (1939). **Fauna**: 3 spp. in southern USA. **Hosts**: predators of eggs of *Saissetia* and *Ceroplastes* (Coccidae) and hyperparasites of these genera through *Scutellista* (Pteromalidae).

30(28) Forewing infuscate from about base of parastigma to or beyond apex of marginal vein **and** with 1 or more discrete hyaline spots (Figs. 160, 161) or a cross-band (Fig. 159) having white setae behind marginal vein 31

– Forewing hyaline or, if partly infuscate (sometimes as distinct mediolongitudinal band, Fig. 158), without discrete hyaline spot(s) or cross-band having white setae behind marginal vein (Figs. 162, 163) 32

31(30) Metasoma with subbasal or basal whitish area at least ventrally and often dorsally (area sometimes obscure if metasoma yellowish); propodeum with plical region small, narrow, usually more or less bow tie-like, and distinctly below plane of abruptly convex or flat, inclined callar regions (Figs. 71–74); mandible with single ventroapical tooth and broad dorsoapical margin (cf. Fig. 37) .... ***Anastatus*** Motschulsky

Key: Burks (1967). **Fauna**: 15 nominal spp., widespread. **Hosts**: usually endoparasites of eggs of Lepidoptera and Hemiptera, less commonly of eggs of Blattaria, Orthoptera, and Mantodea; a few species have been reared as ectoparasites of larvae or pupae of other insects.

– Metasoma uniformly dark; propodeum with plical region varied in length but relatively broad, distinctly sculptured, and in about same plane as callar regions (Figs. 75, 76); mandible with 3 teeth (cf. Fig. 35) .... ***Zaischnopsis*** Ashmead

Note: most described world spp. currently classified in *Anastatus*.

Fauna: at least 4 undescribed spp., in southern Canada and in USA. **Hosts**: unknown, but likely similar to those of *Anastatus*.

32(30) Mandible with single ventroapical tooth and broad dorsoapical margin (Fig. 37); metasoma with syntergum having posterior margin outcurved and narrowly reflexed as apical rim (Fig. 92); eye bare or only very sparsely and inconspicuously microsetose (Fig. 36) .... ***Oozetetes*** De Santis

Fauna: 1 unidentified sp. in USA (southern FL). **Hosts**: unknown, but 1 extralimital sp. reared from oothecae of Blattaria.

– Mandible with 3 teeth (cf. Fig. 35); metasoma with syntergum having posterior margin truncate to slightly emarginate (Figs. 83–86); eye often conspicuously setose (Figs. 33, 34) .... ***Brasema*** Cameron

Note: most described world species currently classified in *Eupelmus*.

Fauna: 22 nominal spp., widespread. **Hosts**: usually larval or pupal, primary or secondary parasites of wide variety of holometabolous insects, often in galls or other protected situations.

33(1) Flagellum filiform and with conspicuously long clava, the clava usually more than half length of funicle and then funicular segments often ring-like (Fig. 113)............***Anastatus*** Motschulsky, see 31

– Flagellum serrate (Fig. 115) or clavate to filiform (Figs. 116–128), but clava not so conspicuously long relative to funicle 34

34(33) Forewing with bare oblique band or broad region (speculum) behind parastigma and base of marginal vein (Fig. 152); head often with 1 conspicuously longer, curved seta near base of mandible behind malar sulcus (seta sometimes obscured by similar setae on lower face) (Figs. 101, 102); mandible with 3 teeth (cf. Fig. 111) .... ***Eupelmus*** Dalman, see 11

– Forewing evenly setose beyond base of parastigma (Fig. 153); head with subequally short setae on gena and lower face (Figs. 103–109); mandible sometimes with single ventroapical tooth and broad, usually slightly concave, dorsoapical margin (Fig. 110) 35

35(34) Head with gena produced as acutely angled vertical lobe adjacent to base of mandible, the mouth margin in anterior view broadly incurved (Fig. 108); mandibles exposed and not crossed over one another when closed, each with small ventroapical tooth and variously long, obliquely angled dorsoapical margin (Fig. 108) .... ***Ecnomocephala*** Gibson, see 10

– Head with gena not produced; mandibles usually partly or entirely concealed under clypeus and crossed over each other when closed (then dentition usually concealed), but either with 3 teeth (Figs. 111, 112) or, if similar to above, dorsoapical margin of mandible slightly concave or truncate (Fig. 110) 36

36(35) Mandible with small ventroapical tooth and broad, truncate to slightly concave, dorsoapical margin (Fig. 110) .... ***Anastatus*** Motschulsky, see 31

– Mandible with 3 teeth (Figs. 111, 112) or dentition not visible 37

37(36) Head with toruli relatively close to mouth margin (distance between toruli distinctly greater than distance between torulus and mouth margin) (Fig. 107); head with distance between posterior ocellus and eye margin subequal to distance between posterior ocelli and twice diameter of posterior ocellus (Fig. 107); funicle 8-segmented, with all segments, including the first, subquadrate (Fig. 114) .... ***Psomizopelma*** Gibson, see 26

– Head with toruli usually at or only slightly below middle of head, but if distinctively close to mouth margin then distance between posterior ocellus and eye margin at most half distance between posterior ocelli and equal to diameter of posterior ocellus; funicle with first segment much shorter than second segment, ring-like (easily overlooked so funicle appearing 7-segmented) (Figs. 115–128) 38

38(37) Antenna with flagellum distinctly clavate and relatively short, at most only about 1.4 times as long as head height, and with pedicel distinctly longer than second flagellar segment (Figs. 116–120) 39

– Antenna usually with flagellum either distinctly filiform (Figs. 123–127) or, if subclavate, with pedicel subequal in length to second flagellar segment (Figs. 121, 128) but, very rarely, flagellum serrate (Fig. 115) 42

39(38) Metacoxa in lateral view setose at least basally and along ventral length (Figs. 135, 136); pedicel ventrally with line of equally spaced, long setae (Figs. 120, 121); mesosoma with prepectus and mesopleuron extensively yellowish 40

– Metacoxa in lateral view bare except sometimes for a few scattered setae ventrobasally (Figs. 131, 132, 134); pedicel ventrally only rarely with differentiated line of setae and then mesosoma laterally entirely metallic green 41

40(39) Metapleuron partly setose along posteroventral margin (Fig. 135).... .... ***Arachnophaga*** (***Brasemopsis*** Brèthes), see 22

– Metapleuron bare (Fig. 136).. .... ***A.*** (***Arachnophaga*** Ashmead), see 21

41(39) Clava relatively slender, with apex tapered to point and with only obscure micropilose area (Fig. 118); mandible with small ventroapical tooth and broad dorsoapical margin (Fig. 110). [Southern Florida.] .... ***Anastatus*** Motschulsky, see 31

– Clava with apex broadly rounded to obliquely truncate, with large ventral micropilose area (Figs. 116, 117); mandible with 3 teeth .... ***Brasema*** Cameron, see 32

42(38) Head almost always with minute pit at apex of interantennal region (Figs. 103, 104); flagellum elongate-filiform, usually conspicuously setose and with inconspicuous longitudinal sensilla (Figs. 125, 126), though rarely with setae relatively sparse and with long sensilla occupying entire length of segment (Fig. 127); flagellum with second segment straight (Figs. 125–127); marginal vein usually distinctively long, at least 0.7 times maximum width of forewing (Fig. 153)................. ***Reikosiella*** Yoshimoto, see 14

– Head without pit at apex of interantennal region (Figs. 102, 105), though sometimes with short sulcus below anterior ocellus (Figs. 99, 100, 106); flagellum different, if elongate-filiform then segments microsetose with dense longitudinal sensilla and second segment usually slightly curved or with concave ventral margin (Figs. 123, 124); marginal vein usually shorter than 0.7 times maximum width of forewing (cf. Fig. 152) 43

43(42) Head with deep, abruptly margined, ∧ -like scrobes extending to anterior ocellus (Fig. 109); flagellum relatively short and stout, with longitudinal sensilla densely packed into multiple rows (cf. Fig. 122); pedicel shorter than second flagellar segment and ventrally with 3 or 4 long setae along length .... ***Lecaniobius*** Ashmead, see 29

– Head with scrobes not abruptly distinguished from parascrobal and interantennal regions (Figs. 95, 96), and usually not extending to anterior ocellus; flagellum highly varied, but if short, stout, and with dense longitudinal sensilla then usually pedicel with at most 1 long ventroapical seta (Figs. 123, 124) 44

44(43) Pedicel at least twice as long as apical width and subequal in length or longer than second flagellar segment, with line of long setae equally spaced along ventral length (Figs. 120, 121); flagellum relatively robust-filiform (Fig. 121) 45

– Pedicel distinctly shorter than second flagellar segment and at most with 1–3 long, obliquely angled setae in ventroapical half (Fig. 122); flagellum often conspicuously elongate-filiform (Fig. 123), though varied in structure 46

45(44) Metapleuron partly setose along posteroventral margin (Fig. 135).... .... ***Arachnophaga (Brasemopsis)*** Brèthes, see 22

– Metapleuron bare (Fig. 136) .... ***A. (Arachnophaga)*** Ashmead, see 21

46(44) Metapleuron setose (Fig. 133); body relatively large (length at least 3 mm) and head and mesosoma with bright metallic sheen; flagellum at least robust with dense longitudinal sensilla, and often more or less serrate (Fig. 115) .... ***Phlebopenes*** Perty, see 14

– Metapleuron bare (Fig. 134); body much smaller and often without metallic sheen or with only dull sheen; flagellum varied, but never serrate 47

47(46) Clypeus differentiated from lower face by distinct tentorial pit or groove and with dorsal surface slightly convex and shiny (Figs. 99, 112); torulus distinctly below lower margin of eye (Fig. 99); mandible relatively gracile, tapered to 3 acute teeth in oblique plane (Fig. 112) .... ***Arachnophaga (Shedocremna)*** Gibson, see 20

– Clypeus sometimes projecting as flat transverse strip, but otherwise not differentiated from lower face and with distinct sculpture (Figs. 100, 111); torulus usually about level with lower margin of eye (Figs. 95–97); mandible more robust, with teeth virtually in vertical plane (Figs. 110, 111) 48

48(47) Mandible with small ventroapical tooth and broad dorsoapical margin (Fig. 110) .... ***Anastatus*** Motschulsky, see 31

– Mandible with 3 teeth (Fig. 111) 49

49(48) Antenna with flagellum robust, with second flagellar segment at most twice as long as broad, and with combined length of pedicel-second segment less than length of scape (cf. Fig. 122); torulus with ventral margin obviously below lower margin of eye (Fig. 100); head and mesosoma with distinct metallic sheen .... ***Arachnophaga*** (***Idoleupelmus***) Ashmead, see 22

– Antenna with flagellum relatively gracile, with second flagellar segment either distinctly more than twice as long as broad or combined length of pedicel-second segment at least equal to length of scape (Fig. 123); torulus often with ventral margin at level of lower margin of eye (Fig. 97); head and mesosoma usually dull brown to black with obscure metallic sheen .... ***Zaischnopsis*** Ashmead, see 31

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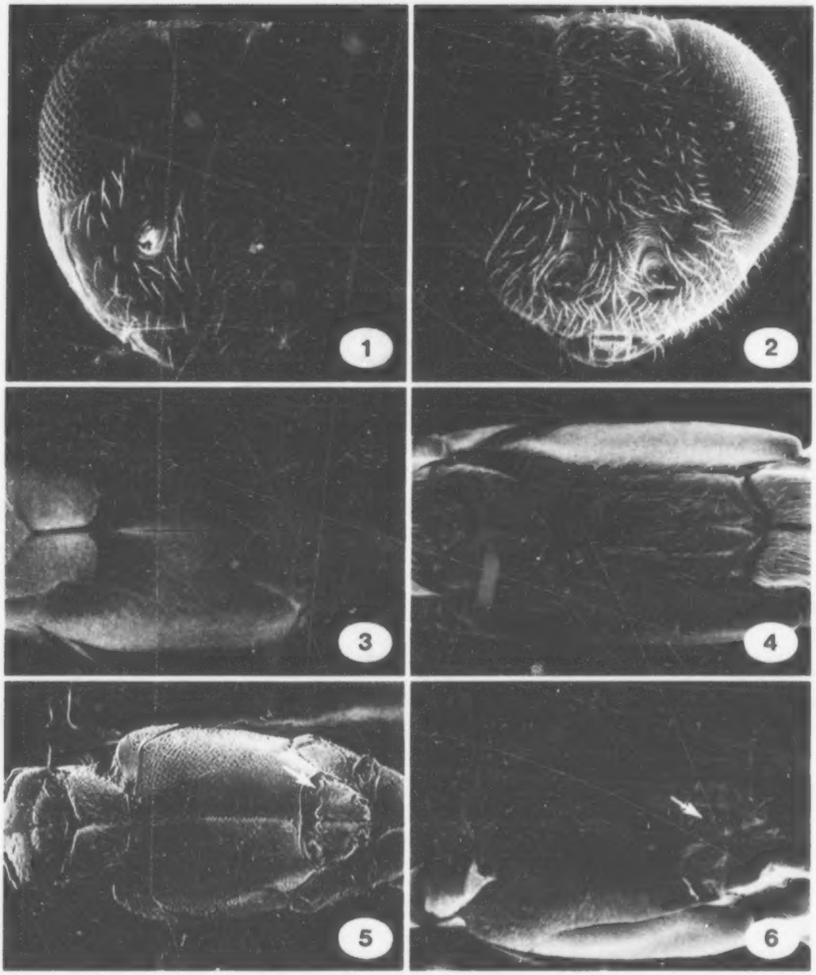

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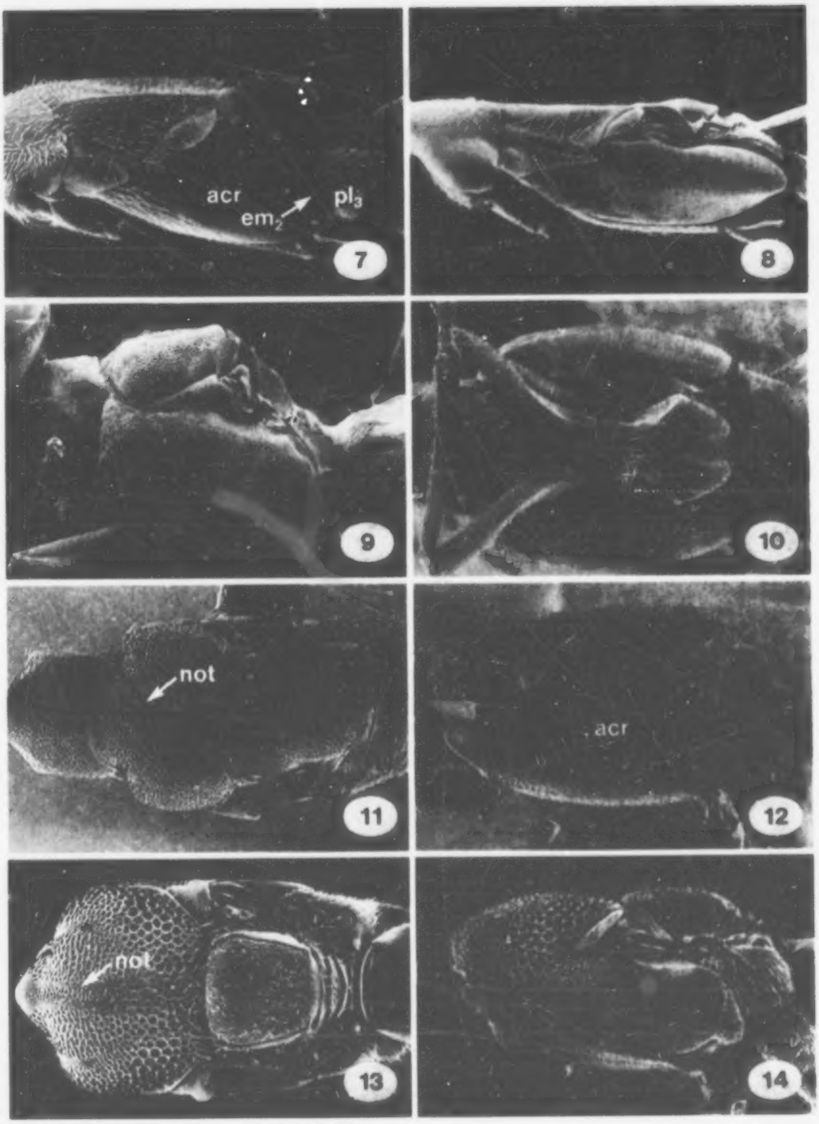
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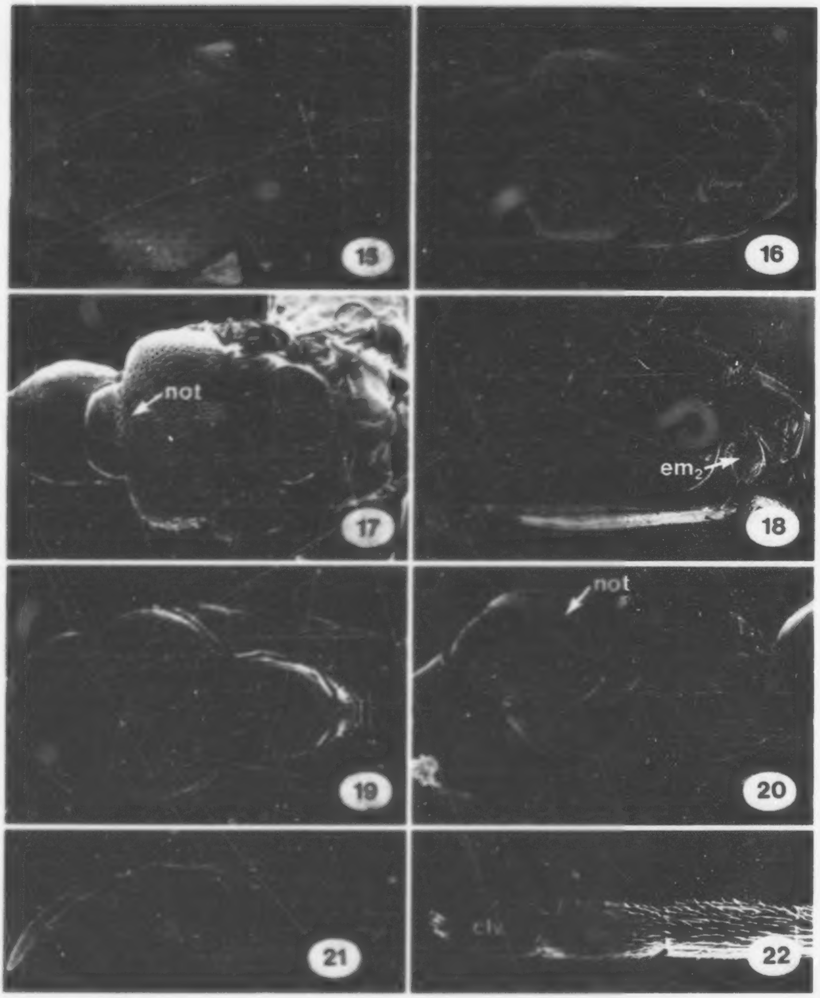
Figs. 7–14. 7–8, mesosoma (lateral): 7, ***Metapelma spectabile*** Westwood ♀; 8, ***Lambdobregma schwarzii*** (Ashmead) ♀. 9–10, ***Eusandalum*** ♂, mesosoma: 9, lateral; 10, ventral. 11–12, ***Archaeopelma tropeotergum*** Gibson ♂, mesosoma: 11, dorsal; 12, lateral. 13–14, ***Balcha*** ♀, mesosoma: 13, dorsal; 14, lateral.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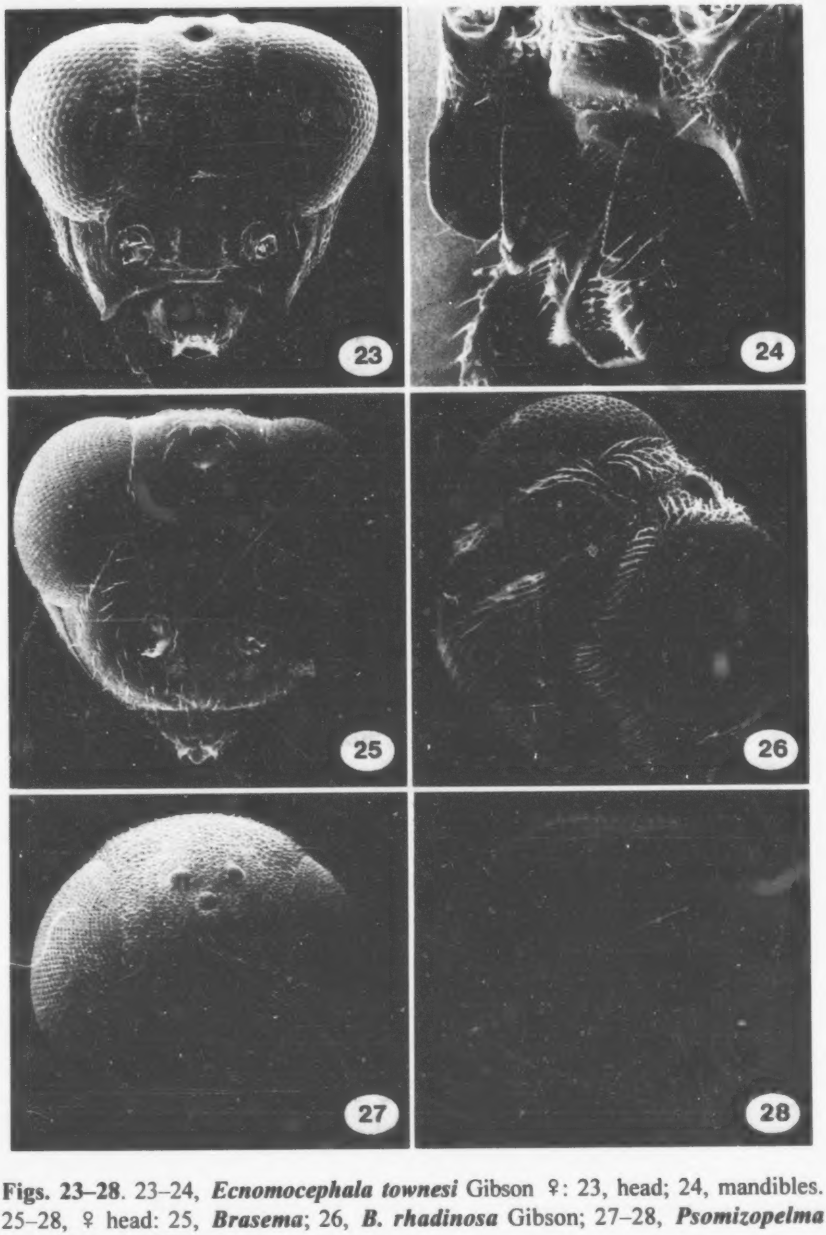
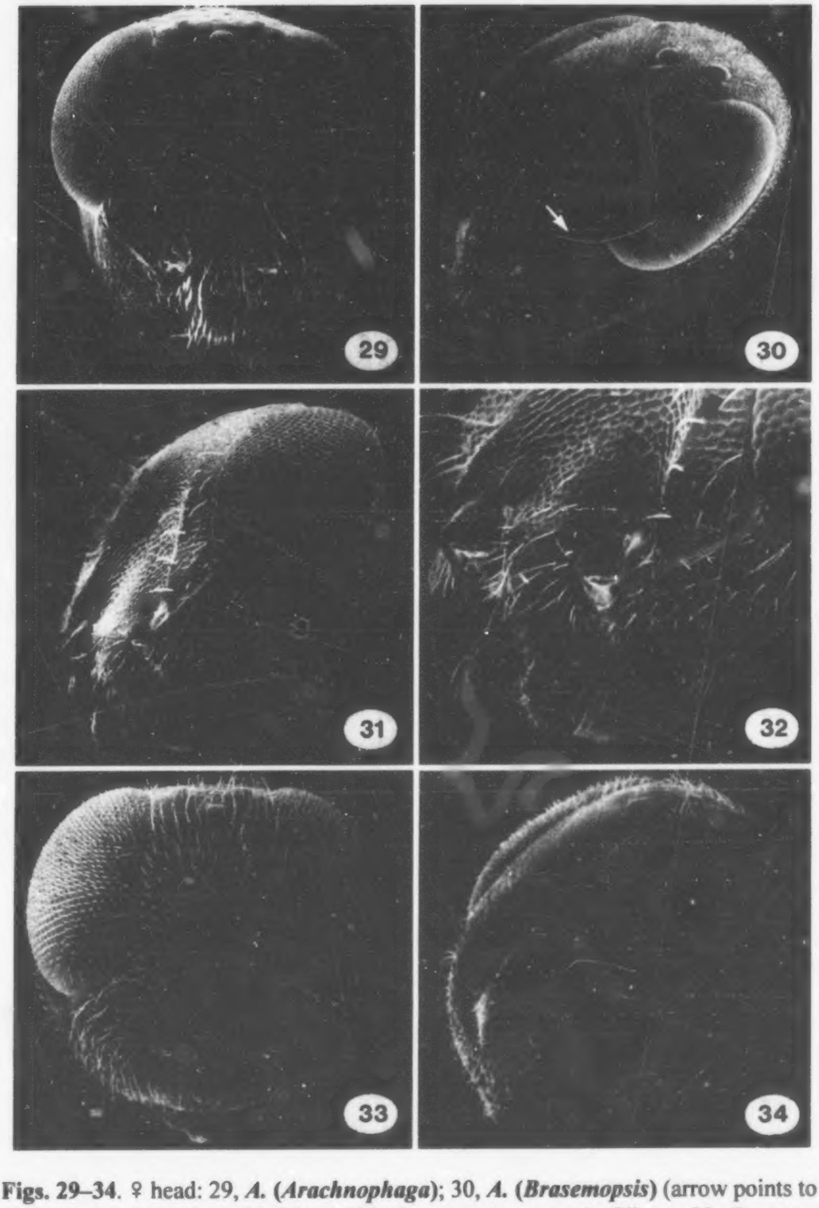
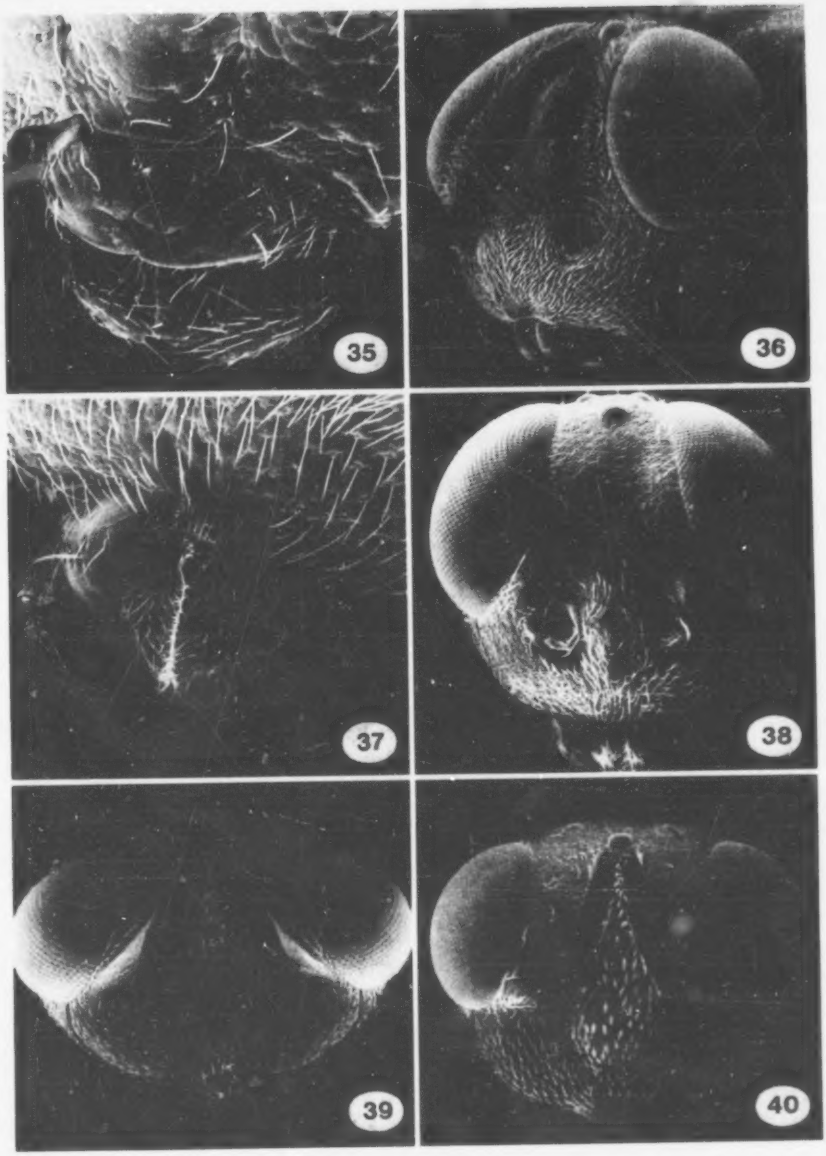
Figs. 15–22. 15–17, mesosoma: 15, ***Eusandalum*** ♀; 16, ***E. cyaneum*** (Ashmead) ♂; 17, ***Licrooides umbilicatus*** Gibson ♂. 18, ***L. umbilicatus*** , mesosoma (lateral). 19–20, ***Calosota metallica*** Gahan ♀, mesosoma: 19, dorsal; 20, lateral. 21, ***Eusandalum*** ♂, antenna. 22, ***Eusandalum*** ♀, apex of flagellum.



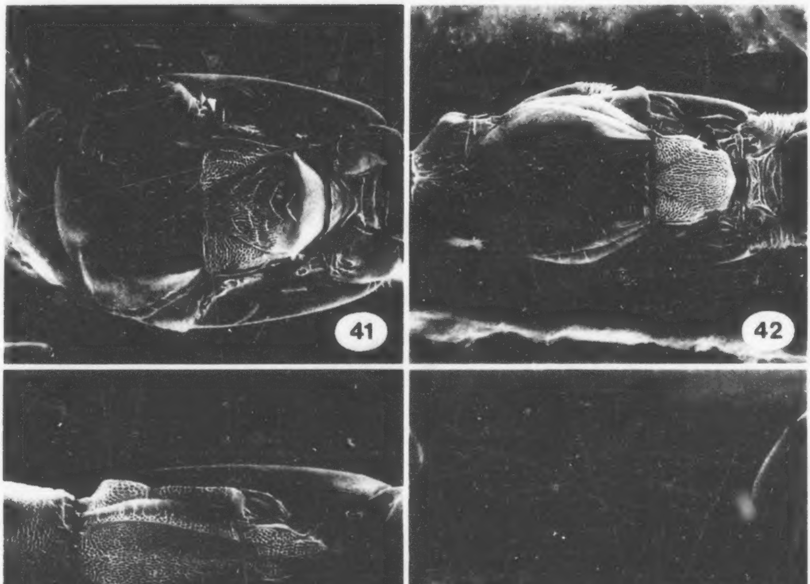
Figs. 23–28. 23–24, ***Ecnomocephala townesi*** Gibson ♀: 23, head; 24, mandibles. 25–28, ♀ head: 25, ***Brasema***; 26, ***B. rhadinosa*** Gibson; 27–28, ***Psomizopelma brachypterum*** Gibson.



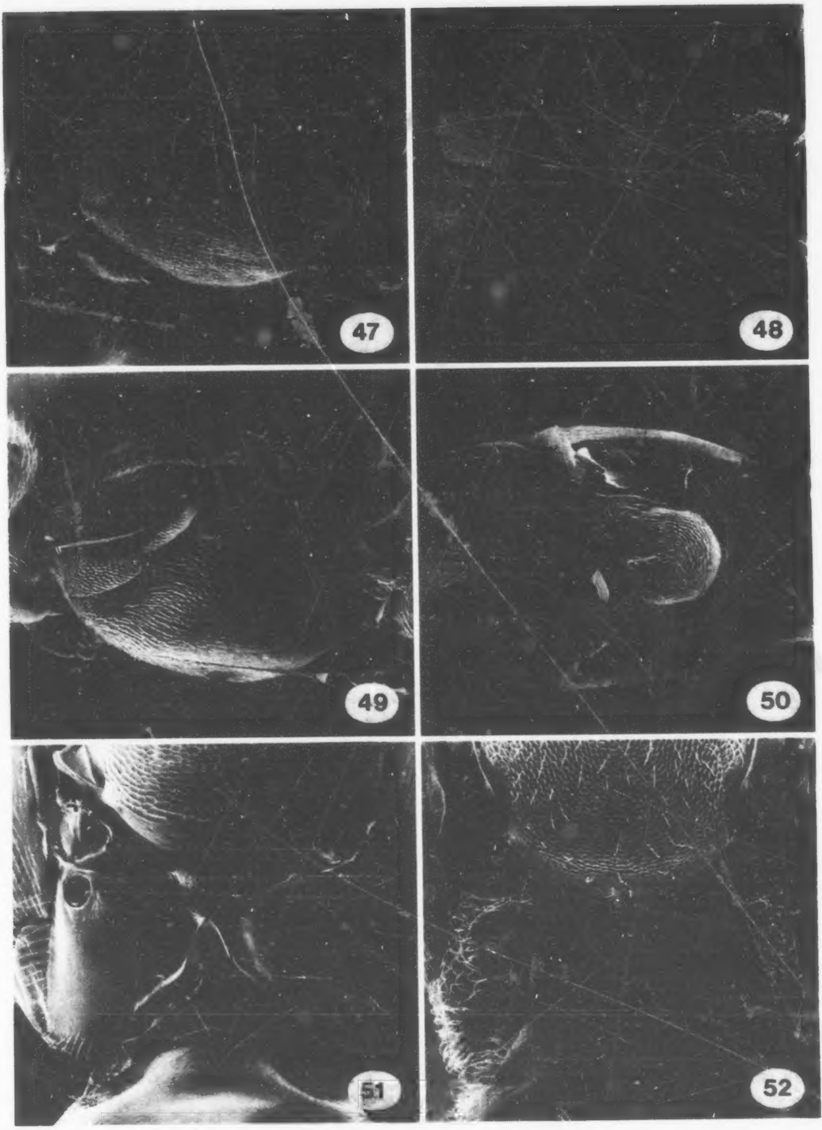
Figs. 29–34. ♀ head: 29, ***A.* (*Arachnophaga*)**; 30, ***A.* (*Brasemopsis*)** (arrow points to oblique, rounded ridge); 31–32, ***A.* (*Shedocremna*) *eucnemia*** Gibson; 33, ***Brasema lacinia*** Gibson; 34, ***B. leucothysana*** Gibson.



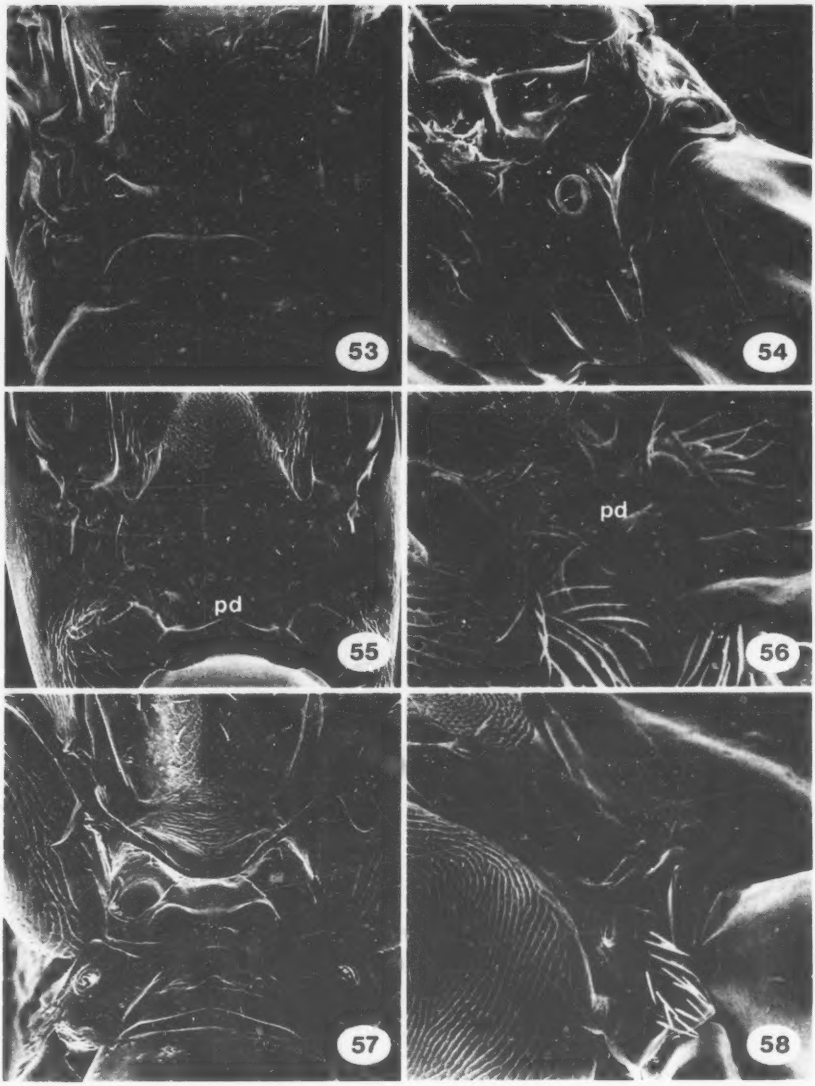
Figs. 35–40. 35, ***Merostenus excavatus*** (Dalman) ♀, mandibles. 36–37, ***Oozetetes*** ♀: 36, head; 37, mandibles. 38–40, ♀ head: 38, ***Tineobiopsis mexicanus*** Gibson; 39, ***Lecaniobius cockerelli*** Ashmead; 40, ***L. utilis*** Compere.



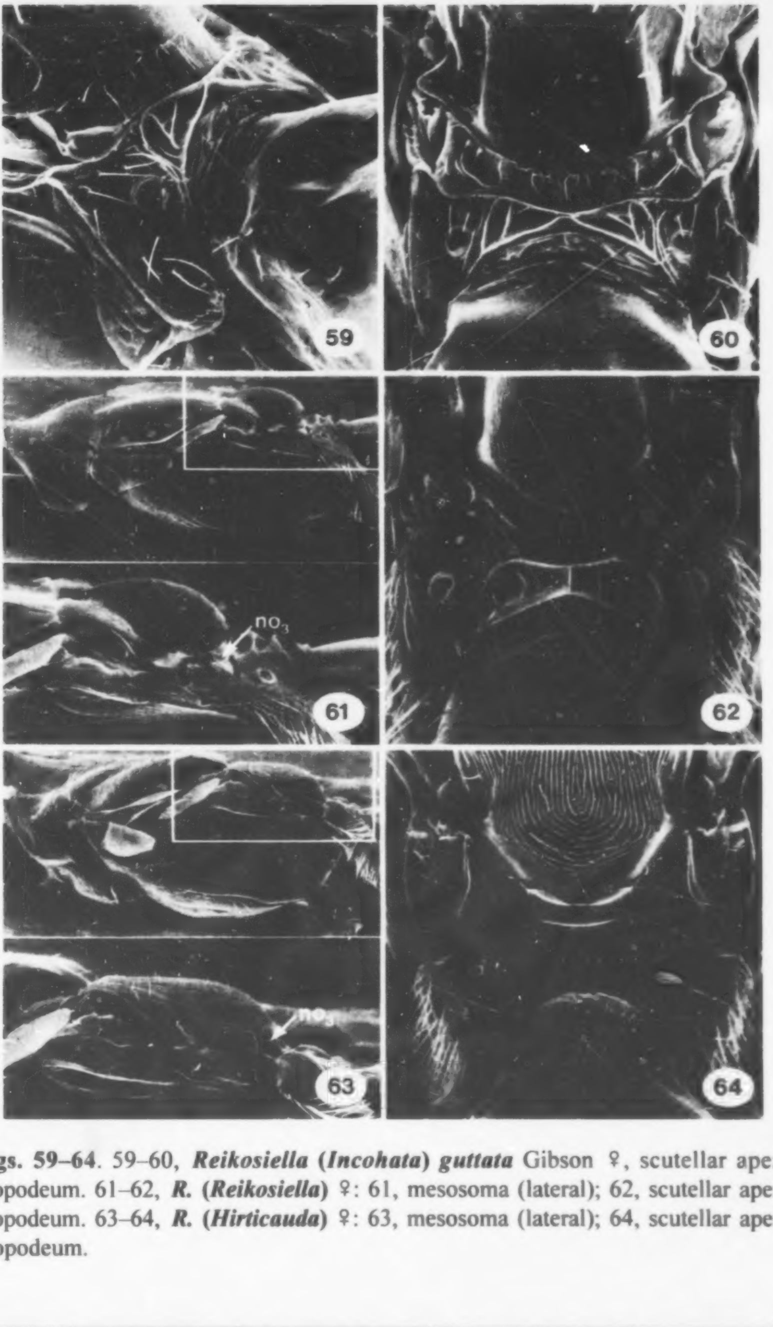
Figs. 41–46. 41–42, ♀ mesosoma: 41, ***Anastatus floridanus*** Roth & Willis; 42, ***Zaischnopsis***. 43–44, ***Uropelma formosum*** Sharkov ♀, mesosoma: 43, dorsal; 44, dorsolateral. 45, ***Eupelmus* (*Macroneura*) *vesicularis*** (Retzius) ♀, mesosoma (dorsolateral) (abbreviation: pr = pronotal ridge). 46, ***Ooderella*** ♀, pronotum and anterior mesonotum (arrow points to setal tuft on acropleuron).



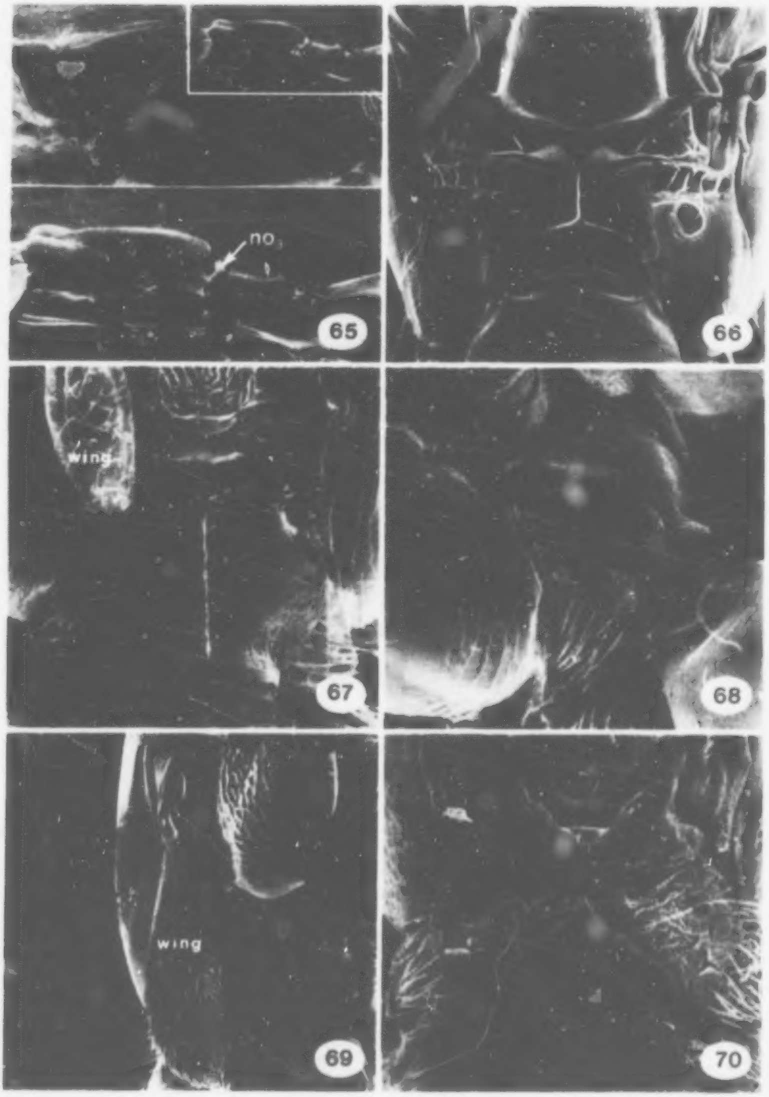
Figs. 47–52. 47–48, ***Arachnophaga* (*Brasemopsis*)** ♀, mesosoma: 47, lateral; 48, dorsal. 49–50, ***A.* (*Idoleupelmus*)** ♀, mesosoma: 49, lateral; 50, dorsal. 51–52, ♀, scutellar apex–propodeum: 51, ***A.* (*Arachnophaga*)**; 52, ***A.* (*Brasemopsis*)**.



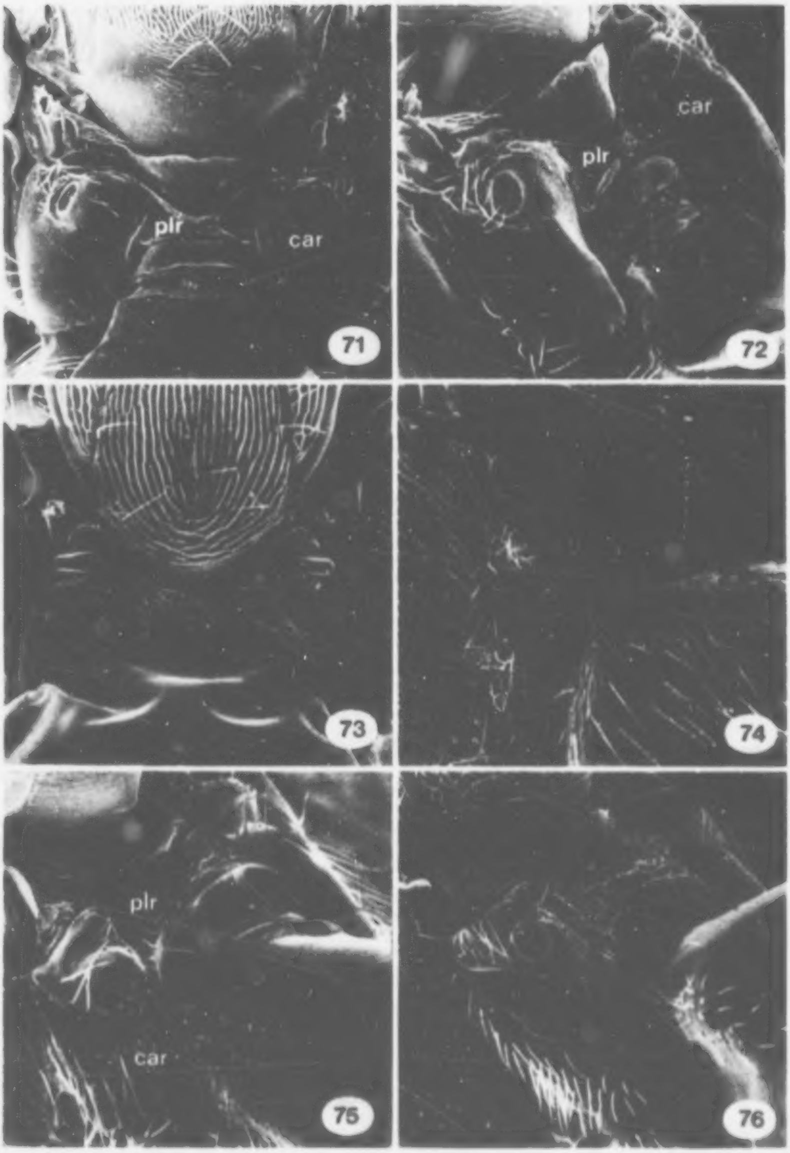
Figs. 53–58. ***Eupelmus*** ♀, scutellar apex–propodeum: 53, ***E.* (*Episolindelia*) *australiensis*** (Girault); 54, ***E.* (*Episolindelia*) *hartigi*** Förster; 55–56, ***E.* (*Eupelmus*)**; 56–57, ***E.* (*Macroneura*)**. (Abbreviation: pd = plical depression.)


59
60
no_3
61
62
no_3
63
64

Figs. 59–64. 59–60, ***Reikosiella* (*Incohata*) *guttata*** Gibson ♀, scutellar apex–propodeum. 61–62, ***R.* (*Reikosiella*)** ♀: 61, mesosoma (lateral); 62, scutellar apex–propodeum. 63–64, ***R.* (*Hirticauda*)** ♀: 63, mesosoma (lateral); 64, scutellar apex–propodeum.



Figs. 65–70. 65–66, ***Reikosiella* (*Capreocauda*)** ♀: 65, mesosoma (lateral); 66, scutellar apex–propodeum. 67–68, ***Ooderella*** ♀: 67, scutellum–propodeum with left forewing; 68, metanotum and propodeum (posterolateral). 69, ***Brasema leucothysana*** Gibson ♀, scutellum–propodeum with left forewing. 70, ***Psomizopelma brachypterum*** Gibson ♀, scutellar apex–propodeum.


plr
car
71
car
plr
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plr
car
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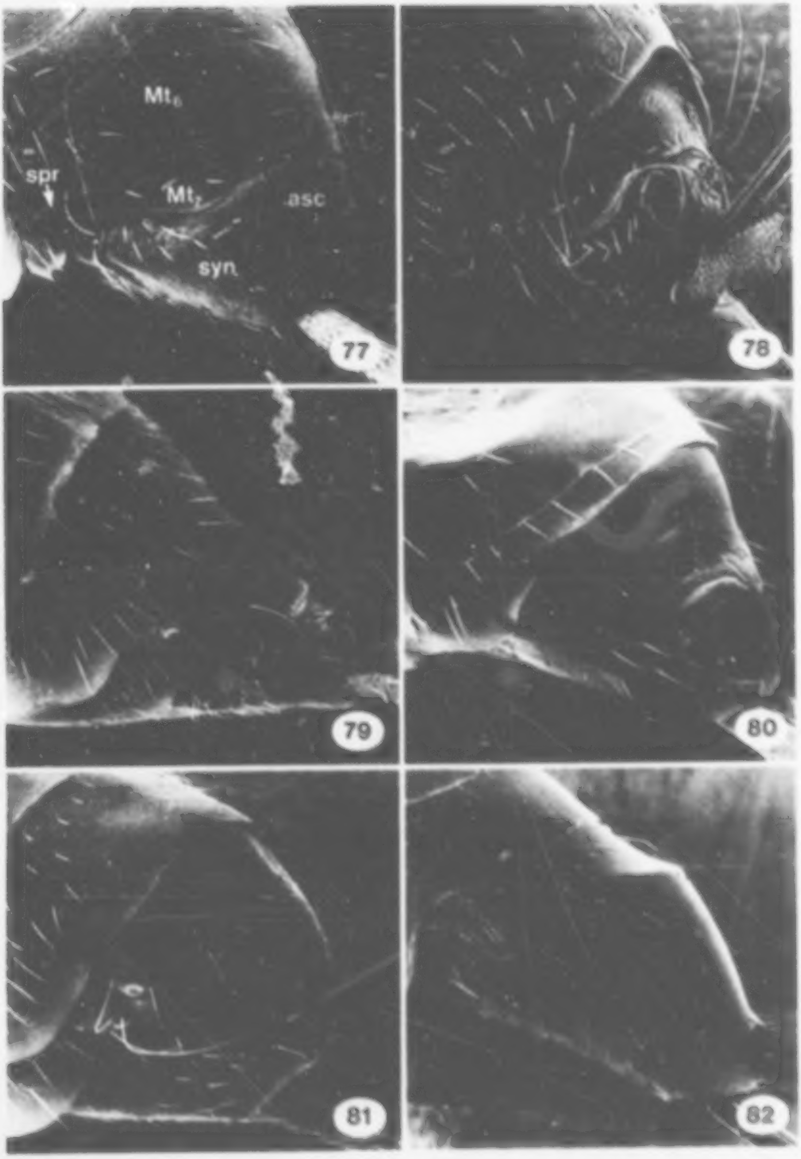
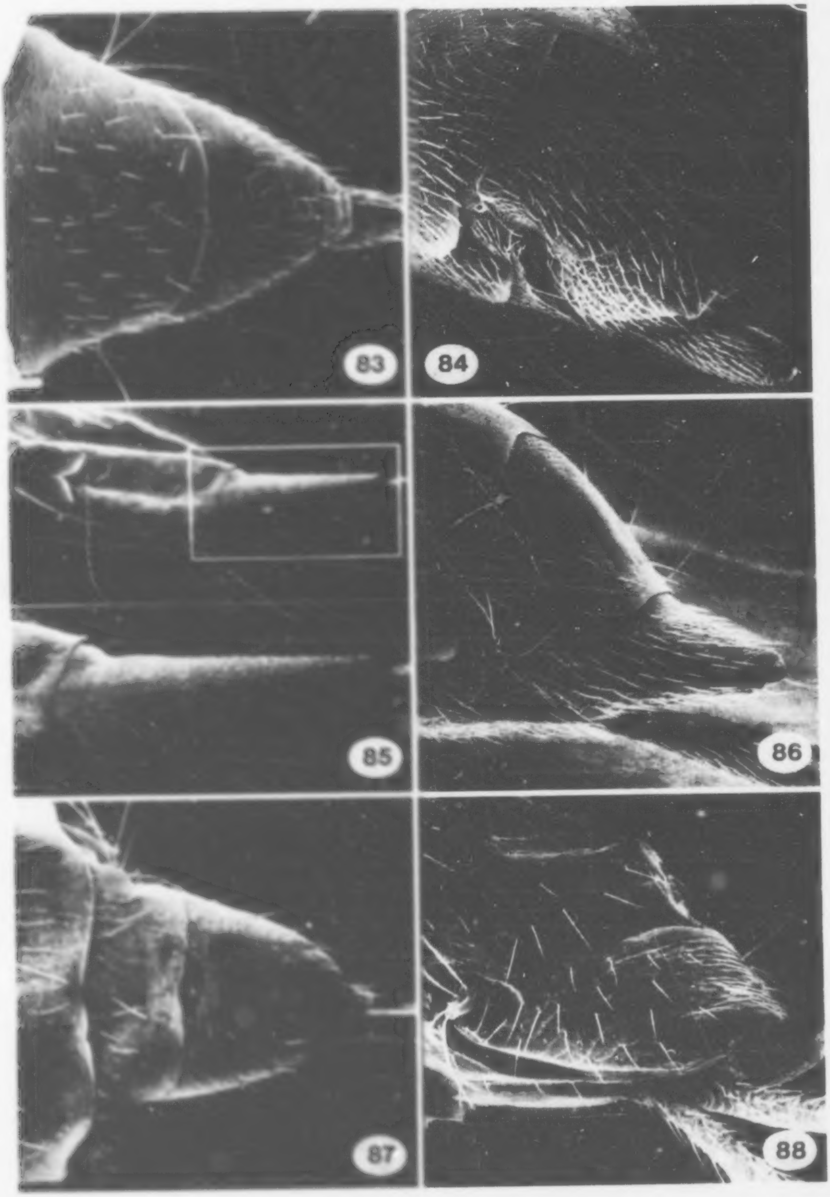
76

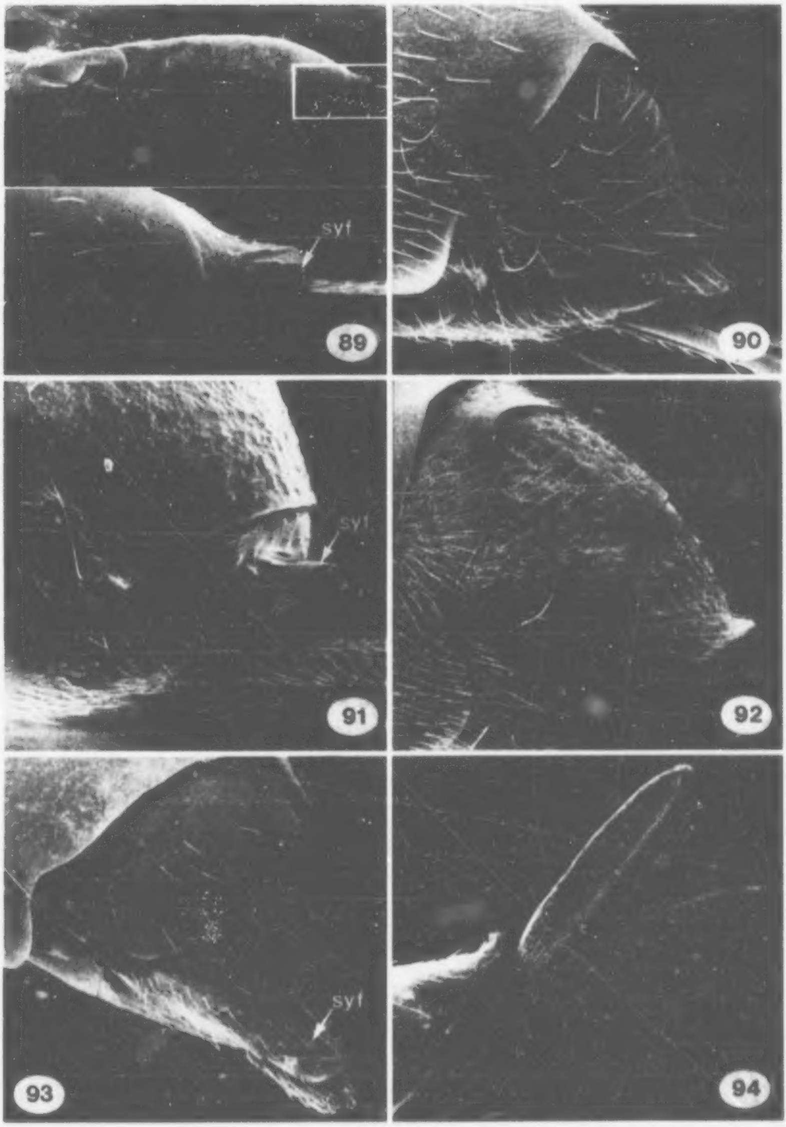
Figs. 71–76. ♀ scutellar apex–propodeum: 71–72, ***Anastatus floridanus*** Roth & Willis; 73, ***A. clavatus*** Gibson; 74, ***A. masneri*** Gibson; 75–76, ***Zaischnopsis***. (Abbreviations: car = callar region, plr = plical region.)


Mt$_6$
spr
Mt$_7$
asc
syn
77
78
79
80
81
82

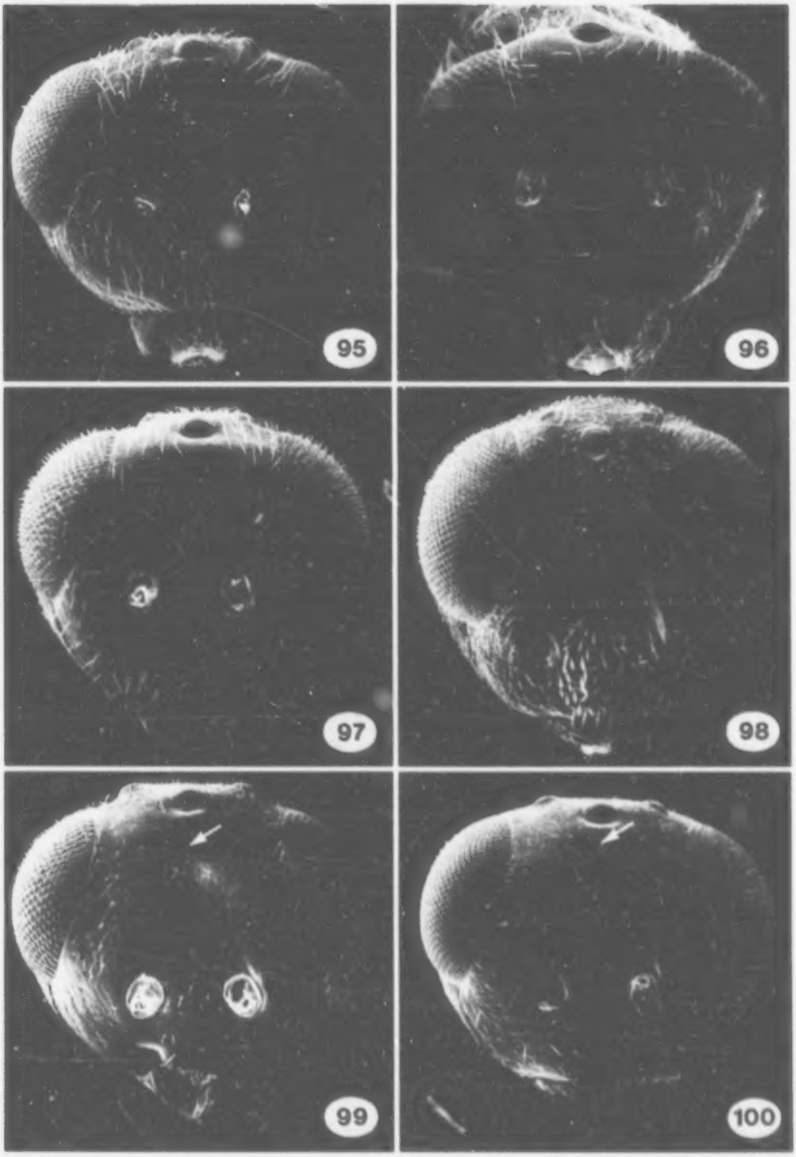
Figs. 77–82. Apex of ♀ metasoma: 77–78, *E.* (***Eupelmus***): 77, natural condition; 78, Mt$_6$ distended; 79, *E.* (***Episolindelia***) ***australiensis*** (Girault); 80, ***Reikosiella*** (***Capreocauda***); 81, *R.* (***Hirticauda***); 82, ***Phlebopenes***.



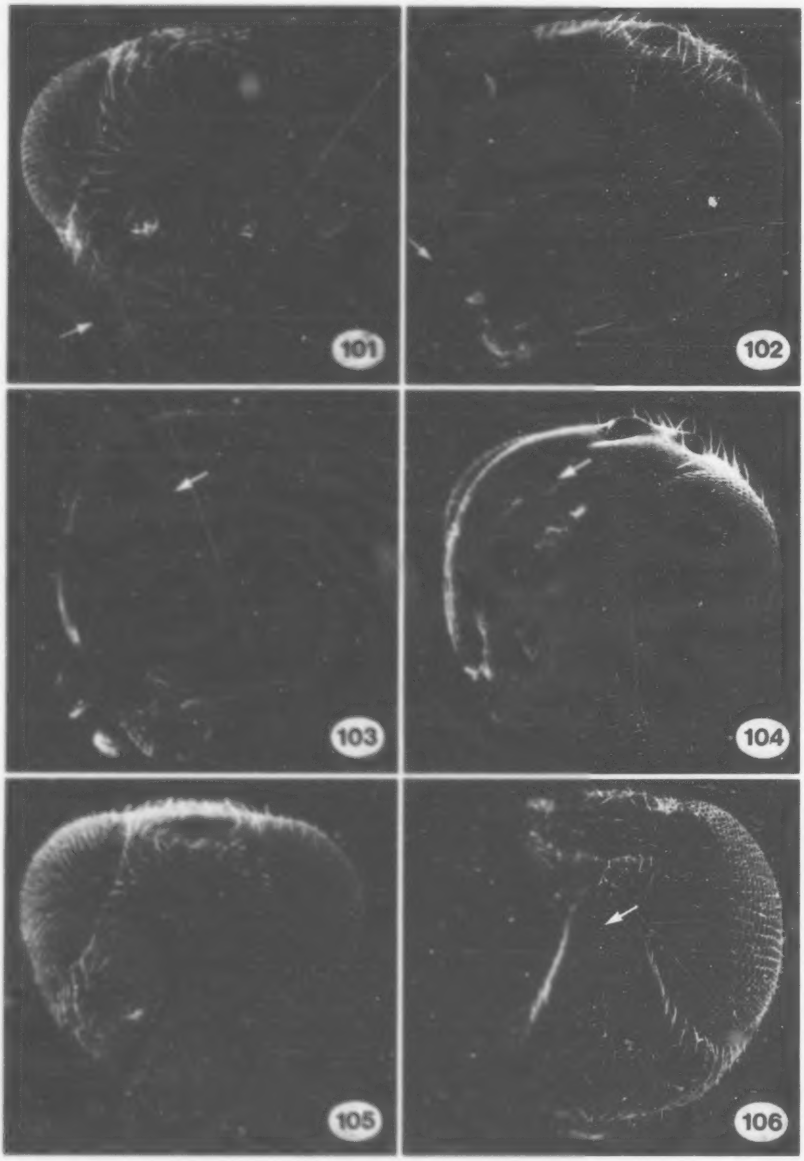
Figs. 83–88. Apex of ♀ metasoma: 83–84, ***Brasema***; 85, ***B. rhadinosa*** Gibson; 86, ***B. leucothysana*** Gibson; 87–88, ***Reikosiella* (*Incohata*) *guttata*** Gibson.



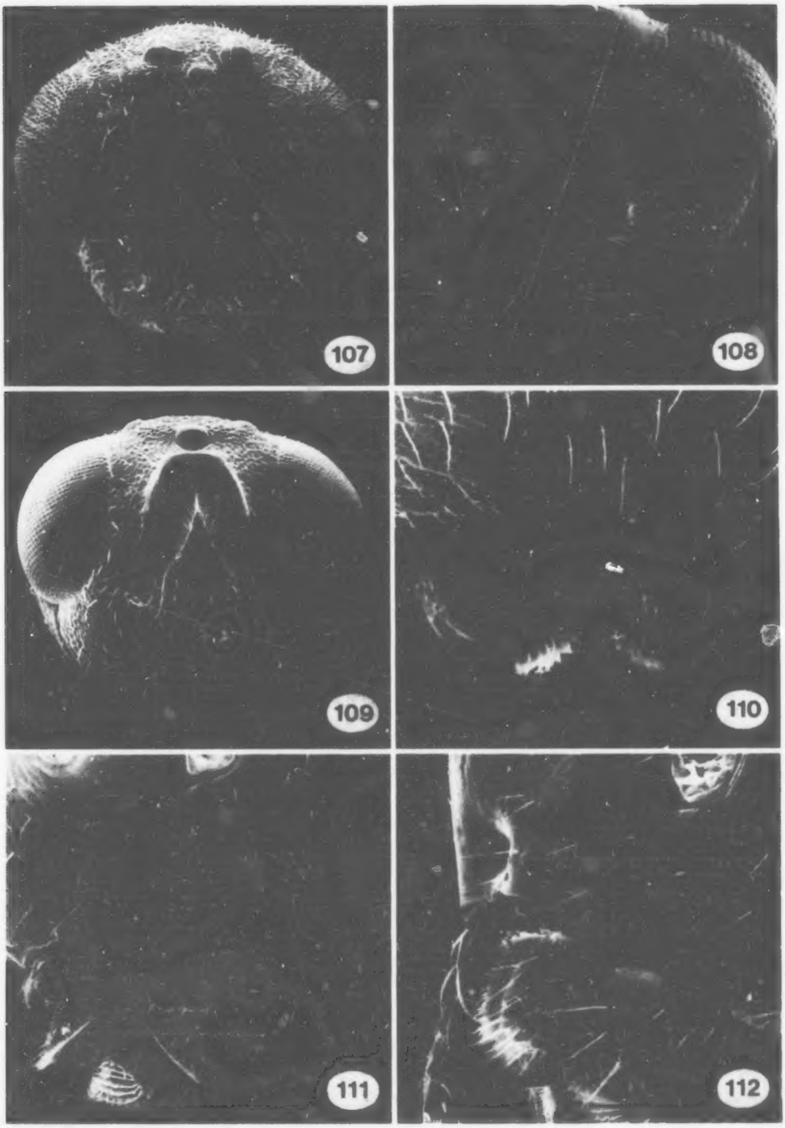
Figs. 89–94. 89–93, apex of ♀ metasoma: 89, ***Zaischnopsis***; 90, ***Arachnophaga*** **(*Idoleupelmus*)**; 91, ***A.*** **(*Arachnophaga*)**; 92, ***Oozetetes***; 93, ***Ooderella***; 94, ***Uropelma formosum*** Sharkov, ovipositor sheaths. (Abbreviation: syf = syntergal flange.)



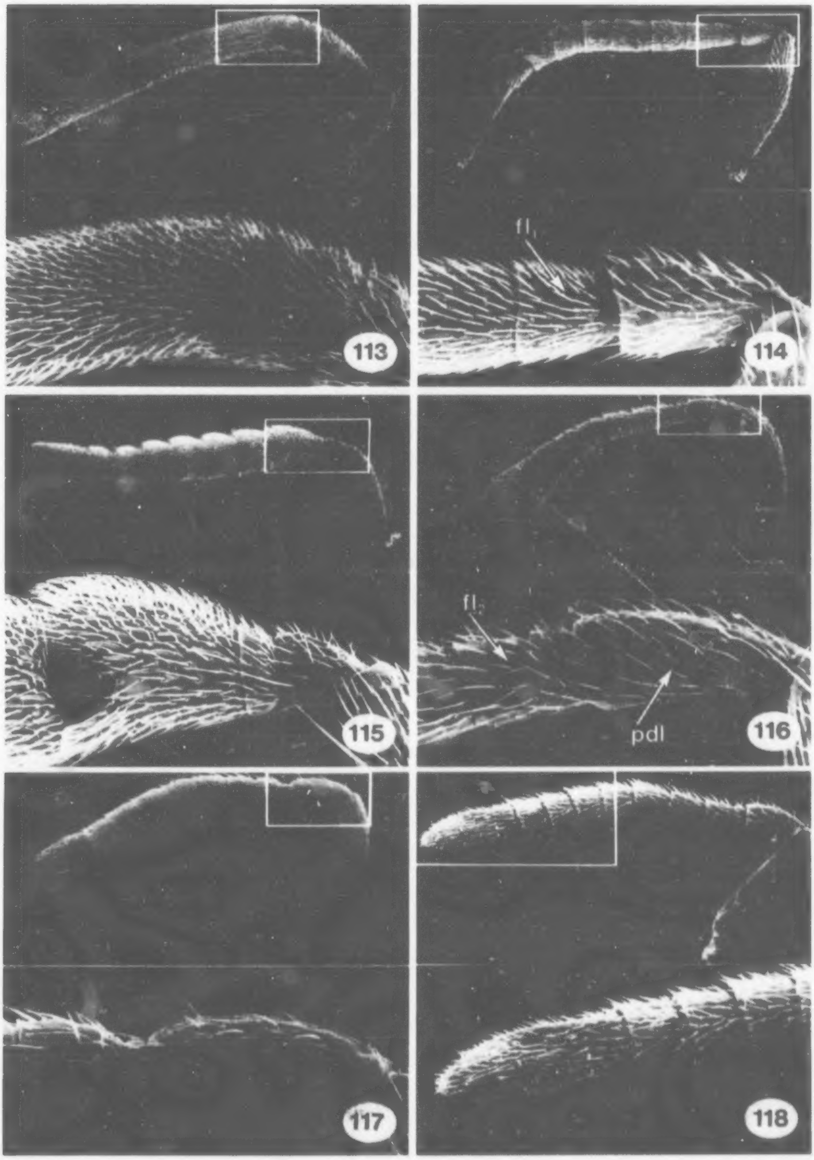
Figs. 95–100. ♂ head: 95, ***Anastatus***; 96, ***A. clavatus*** Gibson; 97, ***Zaischnopsis***; 98, ***Arachnophaga*** **(*Brasemopsis*)**; 99, ***A.*** **(*Shedocremna*)** ***eucnemia*** Gibson; 100, ***A.*** **(*Idoleupelmus*)**. (Arrow on Figs. 99–100 points to subocellar sulcus.)



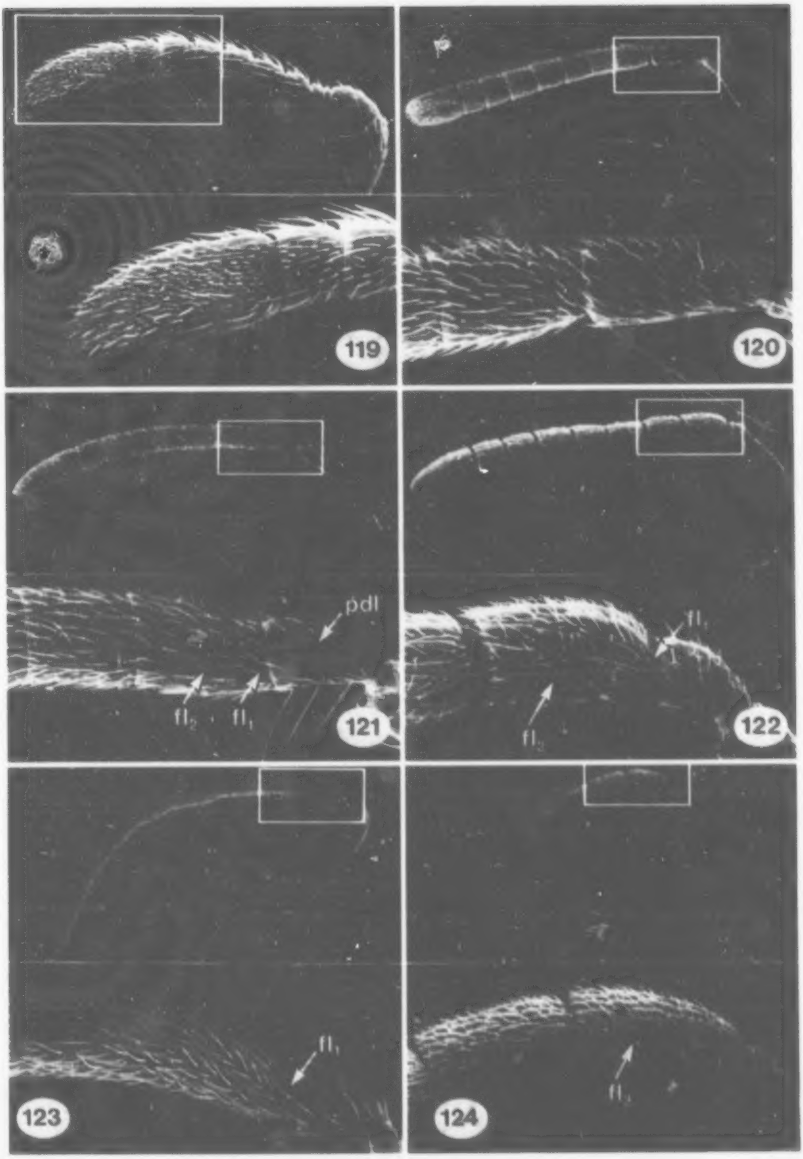
Figs. 101–106. ♂ head: 101–102, ***E.* (*Eupelmus*)**; 103, ***R.* (*Reikosiella*)**; 104, ***R.* (*Hirticauda*)**; 105–106, ***Brasema***. (Arrows: 101–102, point to genal seta; 103–104, point to pit; 106, point to subocellar sulcus.)



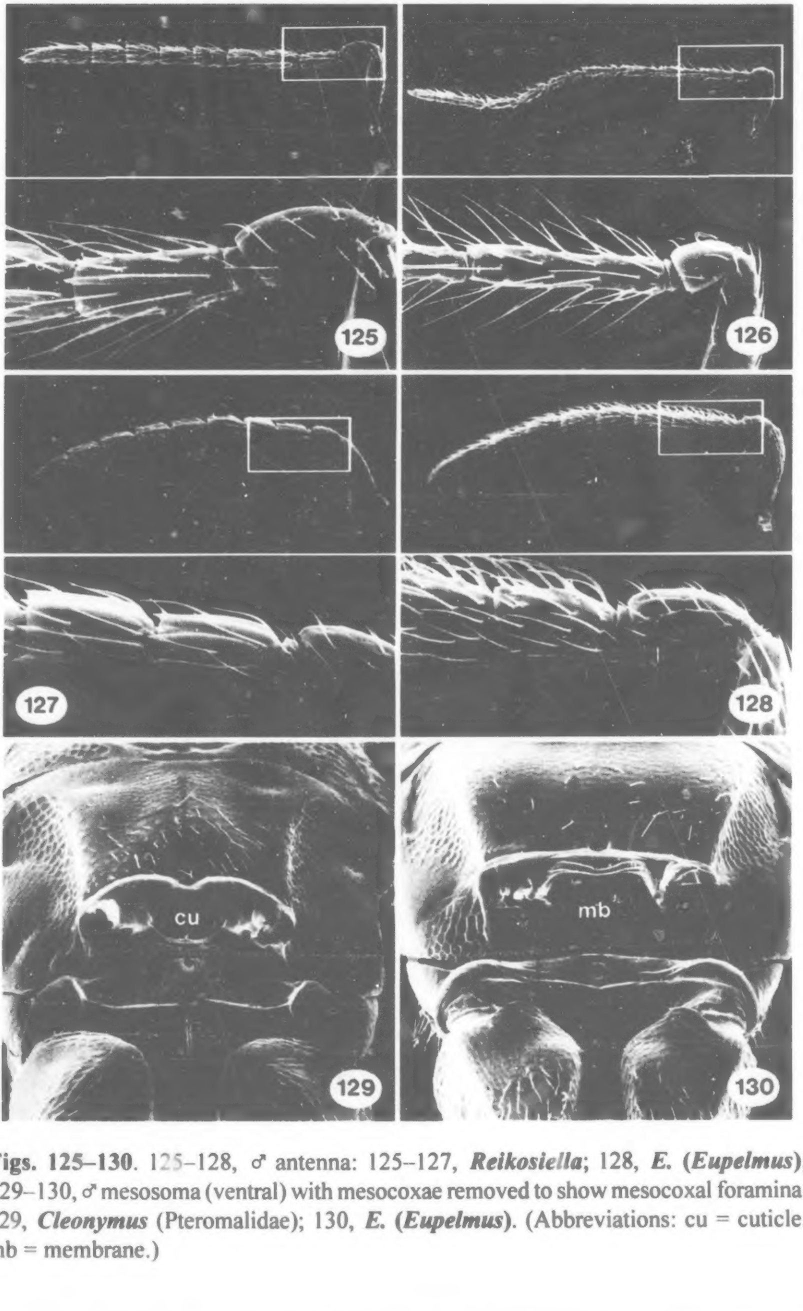
Figs. 107–112. 107–109, ♂ head: 107, ***Psomizopelma brachypterum*** Gibson; 108, ***Ecnomocephala townesi*** Gibson; 109, ***Lecaniobius***. 110–112, ♂ lower face and mandibles: 110, ***Anastatus***; 111, ***R.* (*Reikosiella*)**; 112, ***Arachnophaga* (*Shedocremna*) *eucnemia*** Gibson.


113
fl$_1$
114
115
fl$_2$
pdl
116
117
118

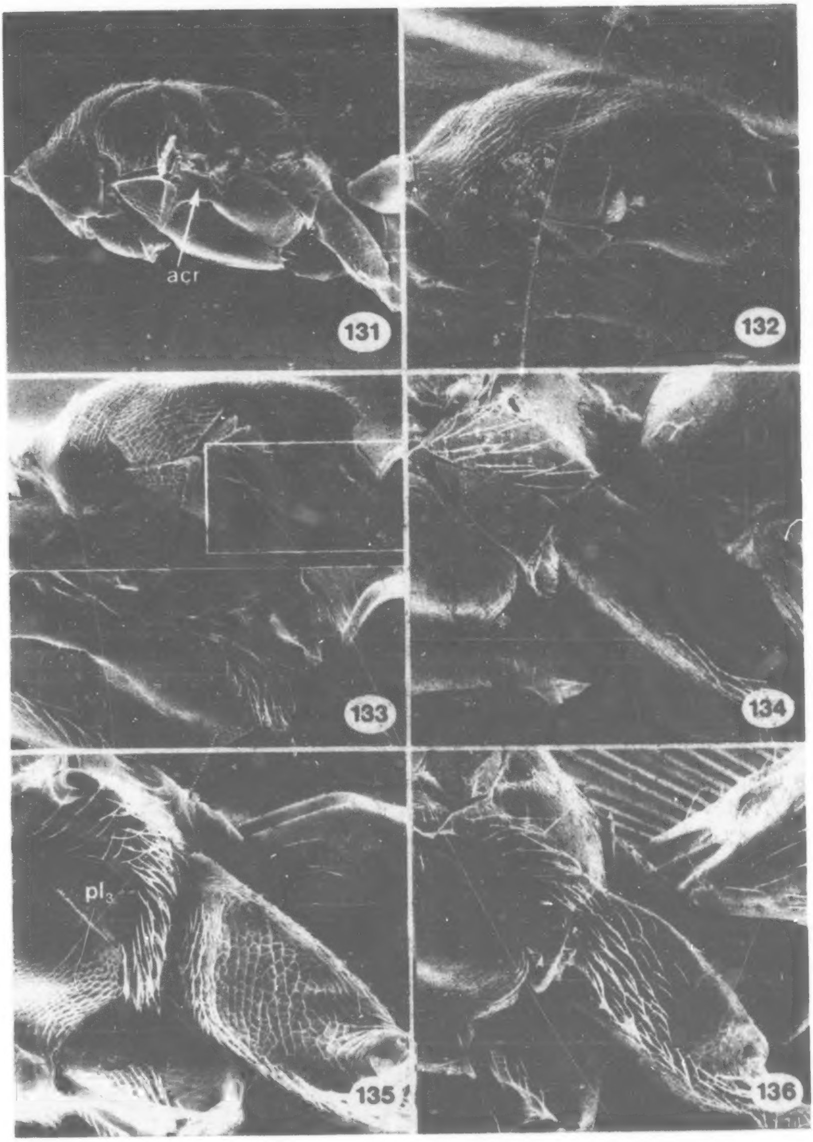
Figs. 113–118. ♂ antenna: 113, ***Anastatus***; 114, ***Psomizopelma brachypterum*** Gibson; 115, ***Phlebopenes***; 116–117, ***Brasema***; 118, ***A. clavatus*** Gibson.


119
120
pdl
fl$_2$
fl$_1$
121
fl$_1$
fl$_2$
122
fl$_1$
123
fl$_1$
124

Figs. 119–124. ♂ antenna: 119, ***Eupelmus* (*Episolindelia*) *australiensis*** (Girault); 120–121, ***A.* (*Arachnophaga*)**; 122, ***A.* (*Shedocremna*) *eucnemia*** Gibson; 123, ***Zaischnopsis***; 124, ***Anastatus***.



Figs. 125–130. 125–128, ♂ antenna: 125–127, ***Reikosiella***; 128, ***E.* (*Eupelmus*)**; 129–130, ♂ mesosoma (ventral) with mesocoxae removed to show mesocoxal foramina: 129, ***Cleonymus*** (Pteromalidae); 130, ***E.* (*Eupelmus*)**. (Abbreviations: cu = cuticle; mb = membrane.)


acr
131
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134
pl_3
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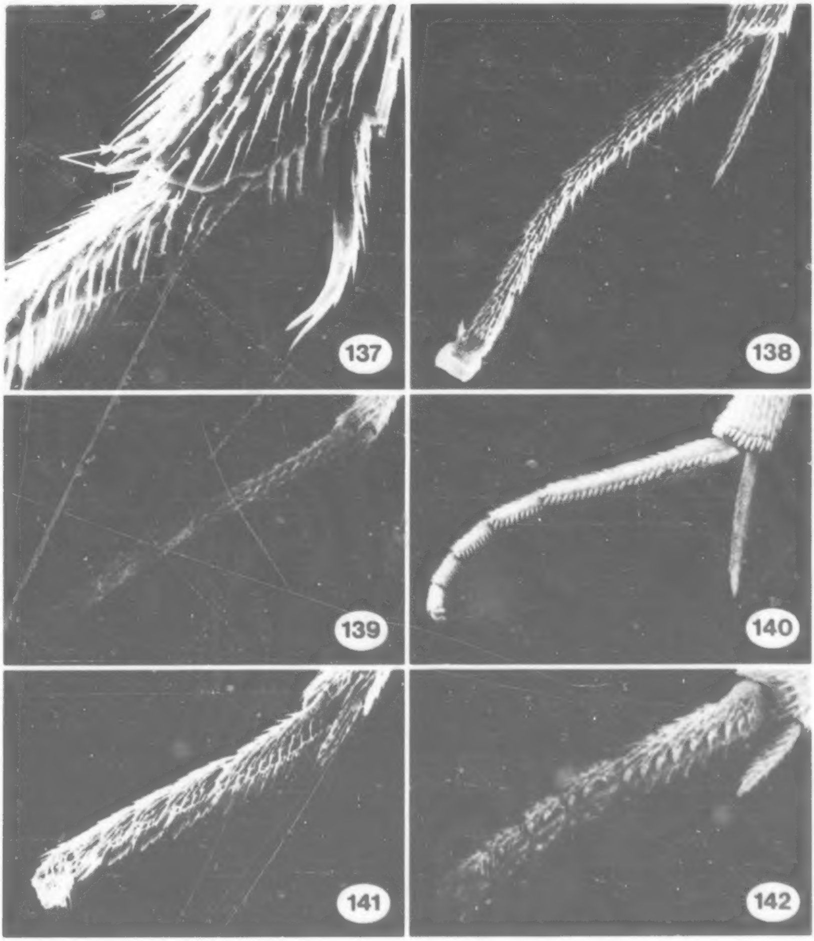
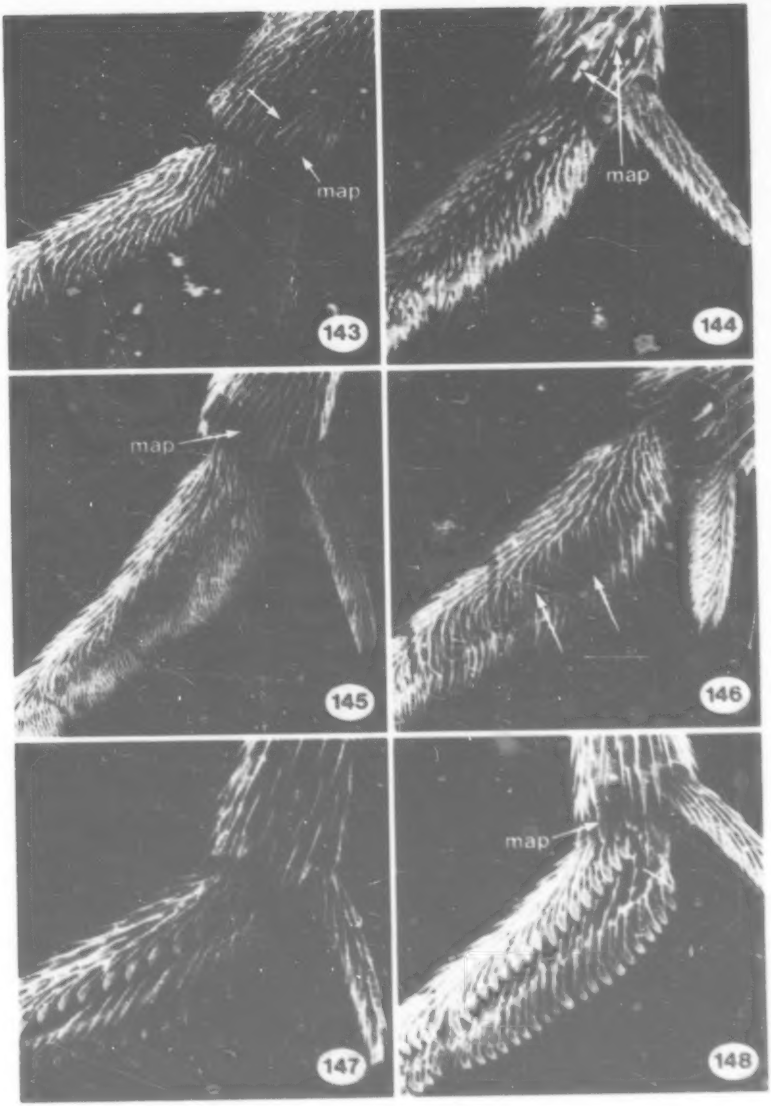
136

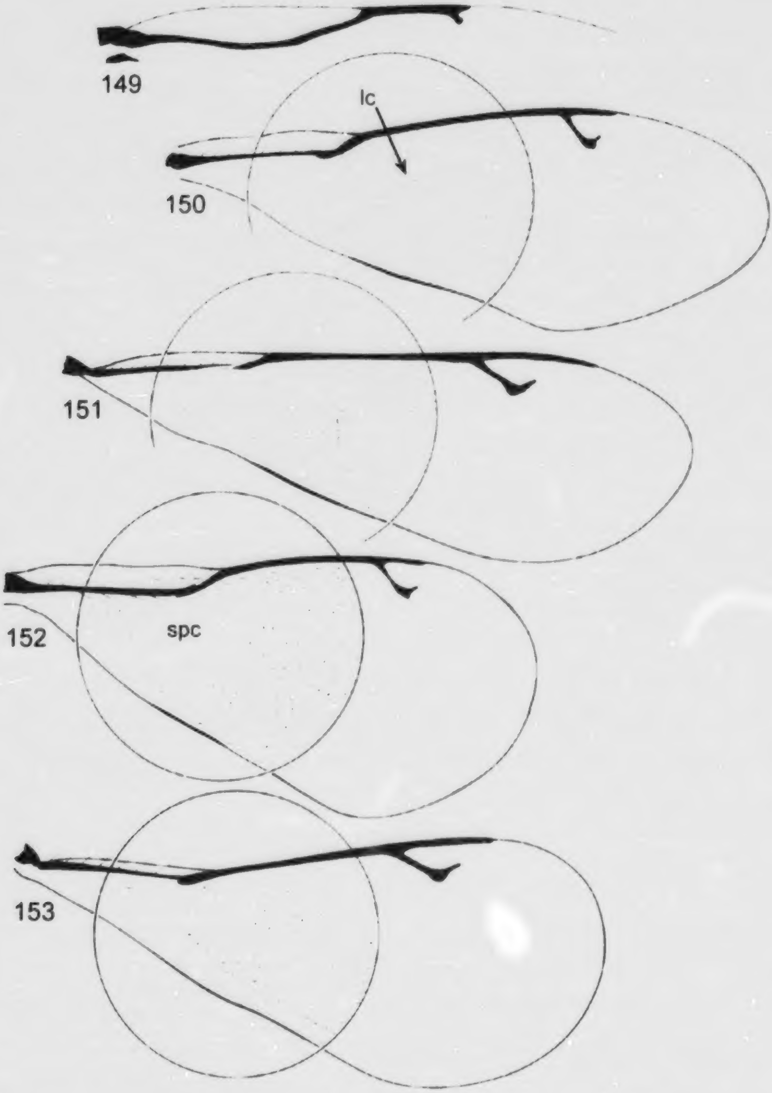
Figs. 131–136. 131–133, ♂ mesosoma (lateral): 131, ***Arachnophaga* (*Shedocremna*) *eucnemia*** Gibson; 132, ***Brasema***; 133, ***Phlebopenes***. 134–136, ♂ metapleuron and metacoxa: 134, ***Anastatus***; 135, ***Arachnophaga* (*Brasemopsis*)**; 136, ***A.* (*Arachnophaga*)**.



Figs. 137–142. 137, ***E.* (*Eupelmus*)** ♂, apex of protibia and base of tarsus (arrows point to apical spicules). 138–142, mesotibial spur and mesotarsus: 138, ***E.* (*Eupelmus*)** ♂; 139, ***Archaeopelma tropeotergum*** Gibson ♂; 140, ***Metapelma spectabile*** Westwood ♀; 141, ***Eusandalum*** ♀; 142, ***Licrooides umbilicatus*** Gibson ♂.



Figs. 143–148. ♀ mesotibial spur and mesotarsus: 143, ***Arachnophaga* (*Idoleupelmus*)** (arrow points to mesotibial apical groove); 144, ***Eupelmus* (*Episolindelia*) *australiensis*** (Girault); 145, ***E.* (*Macroneura*)**; 146, ***E.* (*Eupelmus*)** (arrows point to double row of pegs); 147, ***Reikosiella* (*Incohata*) *guttata*** Gibson; 148, ***R.* (*Hirticauda*)**. (Abbreviation: map = mesotibial apical pegs.)


149
lc
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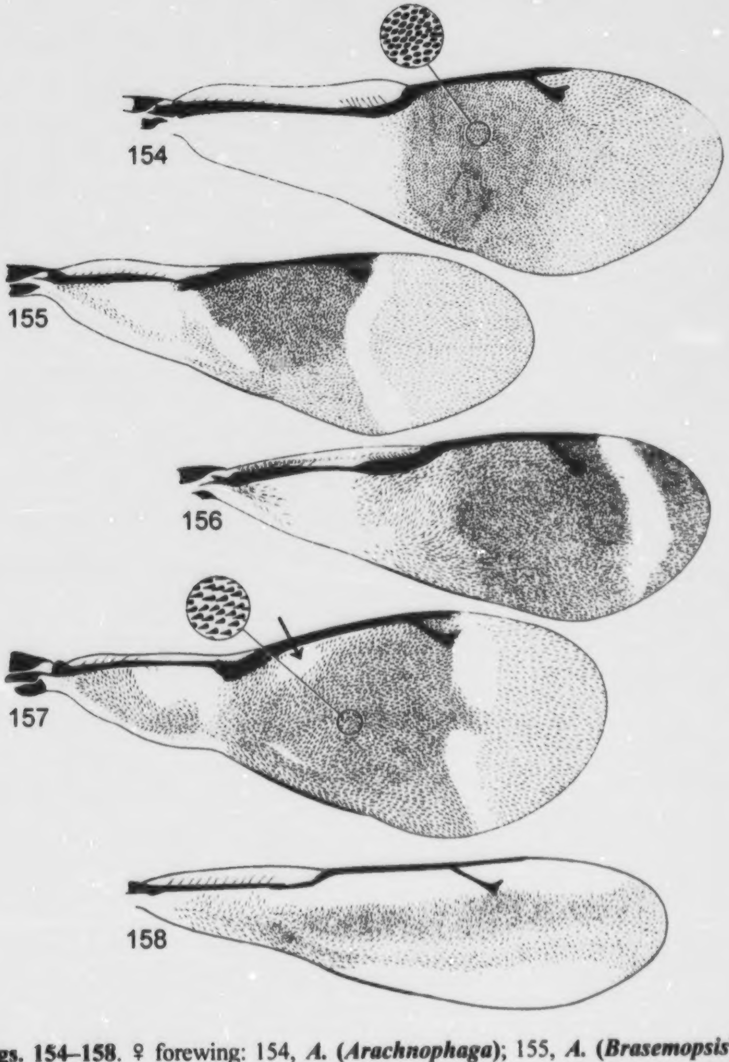
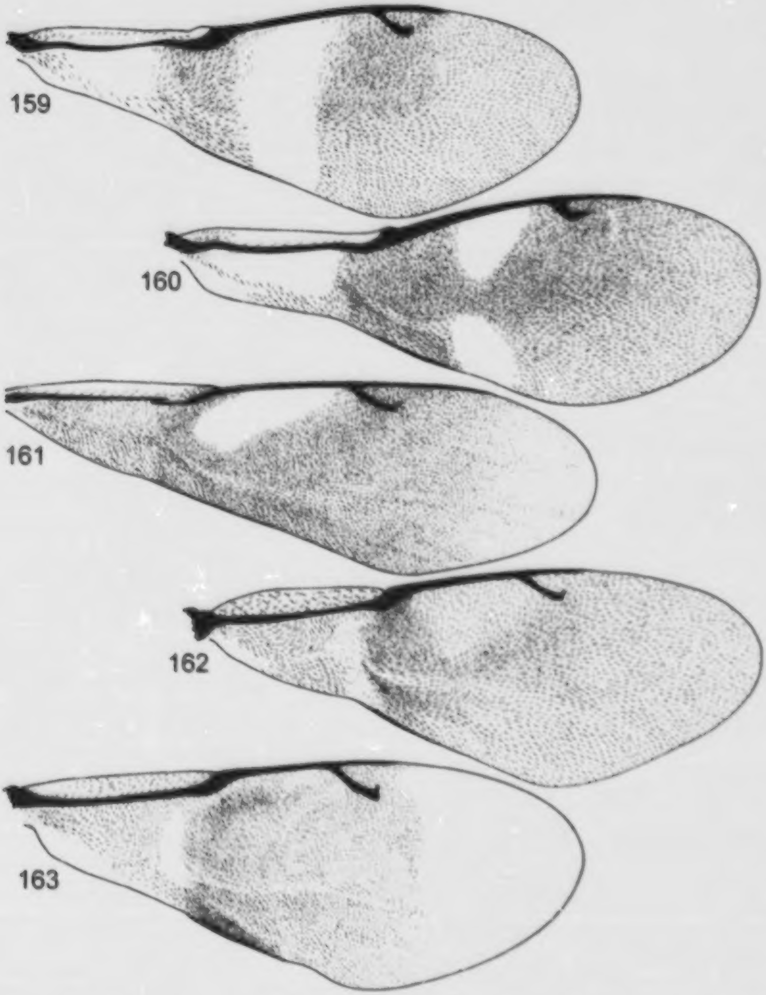
spc
153

Figs. 149–153. 149, ***Licrooides umbilicatus*** Gibson ♀, forewing venation. 150–153, forewing: 150, ***Eupelmus*** ♀; 151, ***Reikosiella*** ♀; 152, ***Eupelmus*** ♂; 153, ***Reikosiella*** ♂.



Figs. 154–158. ♀ forewing: 154, ***A.* (*Arachnophaga*)**; 155, ***A.* (*Brasemopsis*)**; 156, ***A.* (*Idoleupelmus*)**; 157, ***A.* (*Shedocremna*) *eucnemia*** Gibson; 158, ***Brasema rhadinosa*** Gibson. (White areas beyond parastigma represent hyaline areas covered with white setae, except arrow on Fig. 157 points to bare region.)



Figs. 159–163. ♀ forewing: 159–160, ***Anastatus***; 161, ***Zaischnopsis***; 162–163, ***Oozetetes***. (White areas beyond parastigma represent hyaline areas covered with white setae.)

Chapter 12. EURYTOMIDAE

James A. DiGiulio

Recognition. Eurytomidae are most readily recognized by the following combination of features: pronotum rectangular and unusually large (Figs. 1, 23, 35); head and mesosoma covered by sculpture ranging from deep setiferous punctures (Fig. 19) to fine, transverse reticulations (Fig. 20); and color black, black and yellow, or entirely yellow, but only rarely metallic (*Chryseida*).

The family most likely to be confused with Eurytomidae is Pteromalidae. Most pteromalids do not have all the features given above. Additionally, pteromalids have the metasoma depressed, whereas eurytomids usually have the metasoma laterally compressed.

Systematics. Consensus is emerging among many workers such as Bouček (1988), Stage and Snelling (1986), and Grissell and Schauff (1996) to classify Nearctic eurytomids into three subfamilies: Rileyinae, Heimbrinae, and Eurytominae. Other classifications (Burks 1971, 1979; Zerova 1989) divide Eurytomidae into three or four additional subfamilies.

Biology. Eurytomidae attack a wide range of hosts, either as parasites or predators of insects, or as plant feeders, or sometimes both. The family is most comparable in biology to Torymidae, especially in the relatively high degree of phytophagy and the predilection for gall-forming hosts. Excluding for a moment the numerically large and biologically complex genus *Eurytoma*, some summary comments can be made about individual eurytomid genera. Strictly phytophagous genera include two types: gall-formers in grass stems (*Tetramesa*, *Eurytomocharis*, and *Cathilaria*) and seed feeders in various plant families including umbellifers (*Systole*), legumes (*Bruchophagus*), soursop and custard apple (*Bephratelloides*), and grape (*Evoxysoma*). Several of these genera, most notably *Tetramesa*, *Bruchophagus*, and *Systole*, are considered serious pests of agricultural crops. The species of most genera are fairly limited in insect host selection. Genera such as *Bephratoides* and *Ipideurytoma* parasitize wood-boring Coleoptera, and *Chryseida* parasitize seed-feeding Coleoptera. One genus, *Axima*, parasitizes solitary bees (Apoidea) that bore in wood. Two genera are endoparasites of eggs: *Macrorileya* parasitizes eggs of Oecanthinae (Gryllidae) and *Neorileya* parasitizes eggs of Coreidae. *Rileya* attacks gall-forming Cecidomyiidae, as does *Tenuipetiolus*, which also uses Cynipidae as hosts. The somewhat more speciose genus *Sycophila*, at least in the Nearctic region, is primarily parasitic on gall-forming Cynipidae, but also less frequently attacks chalcidoid gall-makers, such as Pteromalidae, Tanaostigmatidae, and often Eurytomidae (especially *Tetramesa*). In other regions, *Sycophila* is commonly associated with fig wasps (Agaonidae).

Eurytoma contains numerous species that essentially overlap the above host range, and includes several additional host groups as well. Several phytophagous species are associated with at least four plant families as both seed feeders and stem borers. Nearctic phytophagous species are found in the seeds of *Rhus*, *Juniperus*, and *Ceanothus*, and in stems of *Pinus*. One species is believed to be phytophagous in fungus associated with *Pinus*. Some Old World species of *Eurytoma* are considered pests in the seeds of agriculturally important crops such as almonds and plums or in silvicultural crops such as maple and larch. At least two Nearctic phytophagous species are thought to be pests: *Eurytoma tumoris* Bugbee (in stems of *Pinus*) and *E. orchidearum* (Westwood) (in stems and leaves of orchids). The latter species is sometimes found as an introduction in greenhouses where orchids are grown. Most species of *Eurytoma* attack gall formers, especially Cynipidae, Tephritidae, and Cecidomyiidae, and to a lesser extent Psyllidae. A few species parasitize concealed Coleoptera and even fewer species parasitize concealed Lepidoptera. Species are known that parasitize sawflies (Symphyta), bees and wasps (Aculeata), and primary parasites such as Braconidae and Ichneumonidae (Ichneumonoidea). *Eurytoma latrodecti* Fullaway is an egg predator in the egg sacs of black widow spiders. *Eurytoma pachyneuron* Girault is believed to be both phytophagous and parasitic in association with *Tetramesa* in grass stems. The ability to feed on both insect and plant tissue has also been reported for Old World species of *Eurytoma* and may be a fairly common occurrence especially with gall-making hosts.

Fauna/Literature. There are 23 genera and 250 species in the Nearctic region, and 79 genera and about 1200 species worldwide. Some generally recognized changes in nomenclature have occurred since Burks (1979). Bouček (1974) synonymized *Eudecatoma* under *Sycophila*; Zerova (1976) synonymized *Gahaniola* under *Tetramesa*; and *Tetramesa* is the senior synonym of *Harmolita*, as proposed by Claridge (1958). A new genus, *Masneroma*, was also added to the fauna (Bouček 1983). The Neotropical genus *Calorileya* is reported for the first time for the Nearctic region.

Use of key. There are some problems in keying eurytomids. Some species are assigned to a genus more because of their biology than because of their morphological features. Many of the genera are easily recognized, but three genera (*Eurytomocharis*, *Evoxysoma*, and *Phylloxeroxenus*) are questionably distinct from *Eurytoma*. It is likely that future work will result in a new concept (or new concepts) of the very large genus *Eurytoma*, which will absorb most of these satellite genera. Males run through the key up to couplet 20 and cannot be separated reliably beyond this couplet.

Key to genera of Eurytomidae

1 Flagellum with 10 or fewer segments, including 1 anellus; prepectus larger than tegula (Figs. 31, 38); postmarginal vein usually shorter to slightly longer than stigmal vein (Figs. 1, 6) .... EURYTOMINAE, 6

– Flagellum 11-segmented, including 2 or 3 anelli (in *Heimbra* and *Macrorileya* the first 2 flagellomeres are short but not as reduced as most anelli, Figs. 9, 12); prepectus smaller than tegula (Fig. 50), except in *Macrorileya* (Fig. 11); postmarginal vein much longer than stigmal vein (Fig. 2) 2

2(1) Scutellum produced posteriorly into large, blunt, spine-like process (Fig. 8); mesosoma and metasoma heavily sclerotized and with large punctures; metasoma covered mostly by large anterior segment consisting of Mt_{2+3} .... HEIMBRINAE, ***Heimbra*** Cameron

Key: Stage and Snelling (1986). **Fauna**: 1 sp., *H. opaca* (Ashmead), throughout arid and semiarid regions of western North America.

– Scutellum not produced into spine; mesosoma and metasoma different .... RILEYINAE, 3

3(2) Forewing with postmarginal vein longer than maximum width of mesosoma; head without genal carina (Fig. 11); prepectus large (Fig. 11). *Female*: metasoma 3 times as long as rest of body (Fig. 10). *Male*: metasoma with Mt_2 and Mt_3 not reduced and metafemur greatly enlarged .... ***Macrorileya*** Ashmead

Fauna: 1 widespread but uncommon sp., *M. oecanthi* (Ashmead). **Hosts**: eggs of tree crickets (Gryllidae: Oecanthinae).

– Forewing with postmarginal vein shorter than maximum width of mesosoma; head with strong genal carina (Fig. 50); prepectus small (Fig. 50). *Female*: metasoma as long as rest of body. *Male*: metasoma with Mt_2 and Mt_3 greatly reduced and metafemur subequal to mesofemur 4

4(3) Flagellum with 2 anelli and 6 funicular segments (Fig. 14); lower face with median carina (Fig. 14); mesonotum with coarse umbilicate punctures. *Both sexes*: metasoma posteriorly rather broad and blunt, and composed mostly of Mt_4 and Mt_5, with Mt_2 and Mt_3 greatly reduced (Fig. 13) .... ***Neorileya*** Ashmead

Fauna: perhaps 2 uncommon spp. in USA (AZ, southern FL). **Hosts**: eggs of Coreidae (Jones 1993).

– Flagellum with 3 anelli and 5 funicular segments (Fig. 16); lower face without median carina; mesonotum with fine, transverse reticulations. *Female*: metasoma sessile, composed mostly of Mt_5, with Mt_2–Mt_4 reduced to three overlapping, dorsal flaps (Fig. 15). *Male*: metasoma with short petiole, composed mostly of Mt_4 and Mt_5, with Mt_2 and Mt_3 reduced 5

5(4) Stigmal vein not ending as swollen knob .... ***Rileya*** Ashmead

Key: Gahan (1918). **Fauna**: 9 spp., widespread. **Hosts**: gall-forming Cecidomyiidae.

– Stigmal vein ending as swollen knob (Fig. 4) ....
.... ***Calorileya*** Crawford

Fauna: 1 unidentified, uncommon sp. in USA (southern FL). **Hosts**: unknown, but Neotropical spp. make galls on orchids (Orchidaceae).

6(1) Forewing with marginal vein dark and enlarged (stigmated) (Fig. 6), and membrane infumate behind marginal vein, the infumation varied from small area adjacent to stigmal vein to large area extending about three-quarters distance to posterior margin ....
.... ***Sycophila*** Walker

Key: Balduf (1932). **Fauna**: 40 spp., widespread. **Hosts**: gall-forming Cynipidae primarily, and other gall-forming Hymenoptera, e.g., *Hemadas* (Pteromalidae), *Tetramesa* (Eurytomidae), *Tanaostigmodes* (Tanaostigmatidae), and Agaonidae and their inquilines.

– Forewing not stigmated or (some *Tetramesa*) wingless 7

7(6) Head without genal carina (Figs. 17, 26, 28). *Female*: metasomal terga subequal in size (Figs. 18, 24, 27). *Male*: funicle with segments cylindrical and with several rows of setae (Fig. 53) to apically pedunculate (Fig. 51); metasomal terga subequal in size 8

– Head with genal carina (Figs. 33, 44, 45). *Female*: metasomal terga not subequal in size, Mt_5 usually the largest (Figs. 43, 46, 47). *Male*: funicle 5- or 6-segmented, each with 2 distinct whorls of setae and apically pedunculate (Fig. 51); metasoma with Mt_2 and Mt_3 reduced 12

8(7) Propodeum sloping in gentle arch from scutellum, at much less than right angle (Fig. 21) 9

– Propodeum at right angle to scutellum or nearly so (Figs. 24, 27) 10

9(8) Mesonotum with coarse, umbilicate punctures (Figs. 18, 19); forewing with postmarginal vein much longer than marginal vein (Fig. 3) .... ***Isosomodes*** Ashmead

Fauna: 1 uncommon sp., *I. giganteus* (Ashmead), in USA (southeastern to TX).

– Mesonotum almost smooth and unsculptured or with fine, transverse reticulations (Fig. 20); forewing, when present, with postmarginal vein shorter than marginal vein .... ***Tetramesa*** Walker

Keys: Phillips and Emery (1919) and Phillips (1936). **Fauna**: 65 spp., widespread. **Hosts**: gall formers in stems of grasses (Poaceae), including rye, wheat, and other cereal grains.

10(8) Body about 5 mm long and densely setose (Figs. 22, 23) .... ***Cathilaria*** Burks

Fauna: 1 uncommon sp., *C. opuntia* (Muesebeck), in USA (CA to TX and south). **Hosts**: gall former in stems of *Hilaria mutica* (Poaceae).

– Body 2 mm or shorter and sparsely setose (Figs. 24, 27) 11

11(10) Mesonotum almost smooth and unsculptured or with fine, transverse reticulations (Figs. 24, 49). *Female*: funicle with first segment slightly elongate, obconical, without longitudinal sensilla, and with only a few setae (Fig. 25) .... ***Systole*** Walker

Fauna: 3 spp., widespread. **Hosts**: phytophagous in seeds of Apiaceae.

– Mesonotum with fine umbilicate, piliferous punctures (Figs. 27, 30). *Female*: funicle with first segment similar to others, with longitudinal sensilla and many setae (Fig. 29) .... ***Bruchophagus*** Ashmead

Key: McDaniel and Boe (1991). **Fauna**: 8 spp., widespread. **Hosts**: phytophagous in seeds of Fabaceae, including clover (*Trifolium*) and alfalfa (*Medicago*).

12(7) Anterior ocellus in scrobal depression (Figs. 32, 34, 52) 13

– Anterior ocellus above scrobal depression (Figs. 37, 48) 15

13(12) Body metallic green to bronze; head with prominent carina extending from ventral margin of eye and along its inner margin to top of head, and sometimes reaching posterior ocellus (Fig. 32) .... ***Chryseida*** Spinola

Fauna: 2 uncommon spp. in USA (southern CA to southern TX, and south). **Hosts**: Bruchidae in seeds of legumes (Fabaceae).

– Body black and yellow to predominantly yellow, but not metallic 14

14(13) Profemur greatly enlarged, usually with ventral row of teeth (Fig. 36); head in dorsal view excavated behind vertex, ∩ -shaped (Fig. 34); pronotum with raised sculpture appearing as series of bumps in lateral view (Fig. 35); metasoma greatly compressed; body mostly black with some black on legs ....***Bephratoides*** Brues

Fauna: 2 widespread but uncommon spp. **Hosts**: wood-boring Coleoptera.

– Profemur not enlarged and without teeth; head different; pronotum with sculpture not as coarse; metasoma not compressed; body mostly yellow with some black dorsomedially, usually as a few black, transverse patches, but legs never with black .... ***Prodecatoma*** Ashmead

Fauna: 2 widespread but uncommon spp. **Hosts**: Cynipidae, and phytophagous in seeds of Vitaceae.

15(12) Head much broader than mesosoma and with large spine on vertex between scrobal depression and protruding eye (Figs. 37, 38, 39); forewing with marginal vein at least about half as long as submarginal vein and postmarginal vein much longer than short stigmal vein (Fig. 5); metasoma with long, slender petiole and with long, slender gaster having Mt_2–Mt_4 reduced and patches of white setae on remaining terga (Fig. 38) .... ***Axima*** Walker

Fauna/Hosts: 2 spp., the widespread but uncommon *A. zabriskiei* Howard on carpenter bees (Anthophoridae: Xylocopinae), and 1 undescribed sp. in USA (southern FL).

– Head only slightly broader than mesosoma (Figs. 1, 41) and without spine on vertex between scrobal depression and non-protruding eye (Fig. 48); forewing venation variable, but usually with marginal vein much shorter than submarginal vein and slightly longer than stigmal vein, and postmarginal vein subequal in length to stigmal vein (Fig. 1); metasoma with petiole short or gaster globular (Fig. 42) or both 16

16(15) Body with top of head and pronotum flattened (Fig. 40) and broad (Fig. 41) 17

– Body with top of head not distinctly flattened, and pronotum convex like rest of mesosoma (Figs. 42, 43) 18

17(16) Head and mesosoma with dense, shallow punctures; pronotum in dorsal view with posterior margin transverse (Figs. 40, 41) .... ***Ipideurytoma*** Bouček & Novicky

Note: Zerova (1978) treated this genus as a synonym of *Eurytoma*.

Fauna: 1 uncommon sp., *I. polygraphi* (Ashmead), in northern North America. **Hosts**: Scolytidae.

– Head and mesosoma with greatly reduced punctures; pronotum smooth and glossy, in dorsal view with posteromedian, triangular extension occupying much of median area of mesoscutum (Fig. 7) .... ***Masneroma*** Bouček

Fauna: 1 rare sp., *M. angulifera* Bouček, in Canada (ON) and USA (CT, NY).

18(17) Funicle 6-segmented and clava 2-segmented; forewing with light brown infumation behind stigmal and marginal veins .... ***Bephratelloides*** Girault

Key: Grissell and Schauff (1990). **Fauna**: 1 uncommon sp., *B. cubensis* (Ashmead) in USA (southern FL). **Hosts**: phytophagous in seeds of *Annona* (Annonaceae).

– Funicle 5-segmented and clava 3-segmented; forewing without infumate marks 19

19(18) *Both sexes*: propodeum vertical, at right angle to scutellum. *Female*: petiole longer than metacoxa; metasoma anterodorsally often produced forward, giving appearance of petiole inserting into metasoma posterior to Mt_2 and Mt_3 (Fig. 42). *Male*: petiole at most twice as long as metacoxa .... ***Tenuipetiolus*** Bugbee

Key: Bugbee (1951). **Fauna**: 4 spp., widespread. **Hosts**: gall-forming Diptera and Hymenoptera.

– *Both sexes*: propodeum sloping in a gentle arch from scutellum, at much less than right angle, except scutellum vertical in *Phylloxeroxenus*. *Female*: petiole not longer than metacoxa; metasoma not produced anteriorly as above. *Male*: petiole at most 1.5 times as long as metacoxa 20

20(19) Head and mesosoma with sculpture greatly reduced, the head dorsally without umbilicate punctures; Mt_5 laterally not covered with fine reticulations. *Female*: metasoma elongate; propodeum with shallow, broad, median furrow, the furrow nearly obscure anteriorly and becoming more defined and narrower posteriorly .... ***Eurytomocharis*** Ashmead

Key: Bugbee (1966). **Fauna**: 10 spp., widespread. **Hosts**: gall formers in stems of grasses (Poaceae).

– Head and mesosoma entirely covered with umbilicate punctures; Mt_5 with fine reticulations laterally, the reticulations tending to disappear dorsally toward median. *Female*: metasoma variable (some *Eurytoma* with elongate metasoma resemble *Eurytomocharis*, but with deep, narrow, propodeal furrow) 21

21(20) *Female*: metasoma elongate (Fig. 43), at most 1.75 times as long as mesosoma, with combined length of Mt_2–Mt_5 equal to length of mesosoma; Mt_5 in dorsal view longer than Mt_2–Mt_4 combined and Mt_5 lightly sculptured laterally .... ***Evoxysoma*** Ashmead

Fauna: 2 uncommon but widespread spp. **Hosts**: phytophagous in seeds of *Vitis* (Vitaceae).

– *Female*: metasoma not as elongate, usually little longer than mesosoma, but if elongate then combined length of Mt_2–Mt_5 less than length of mesosoma 22

22(21) Mt_5 longer than combined length of Mt_2–Mt_4 and half as long as metasoma; propodeum vertical, at right angle to scutellum .... ***Phylloxeroxenus*** Ashmead

Fauna: 1 sp., *P. phylloxerae* (Ashmead), in eastern North America. **Hosts**: larvae of Cecidomyiidae in *Phylloxera* galls (Phylloxeridae).

– Mt_5 the largest tergum, but not as long as above .... ***Eurytoma*** Illiger

Key: Bugbee (1967). **Fauna**: 92 spp., widespread. **Hosts**: parasites of Coleoptera, Diptera, Homoptera, Hymenoptera, Lepidoptera, and eggs of Theridiidae, and/or phytophagous on species of at least 4 plant families.

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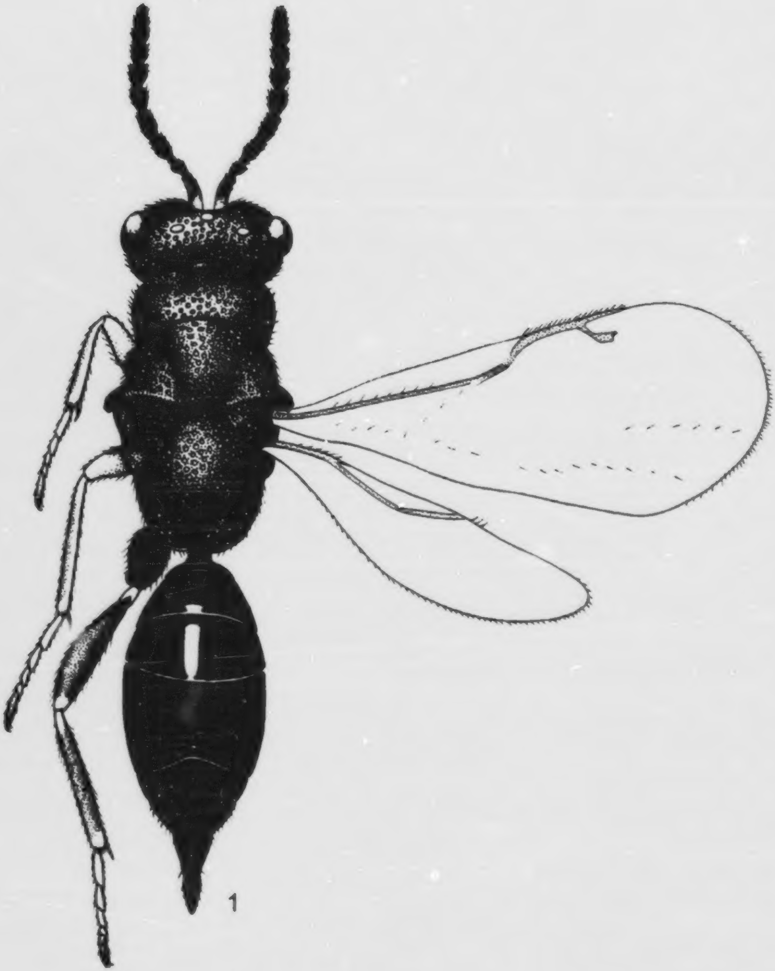
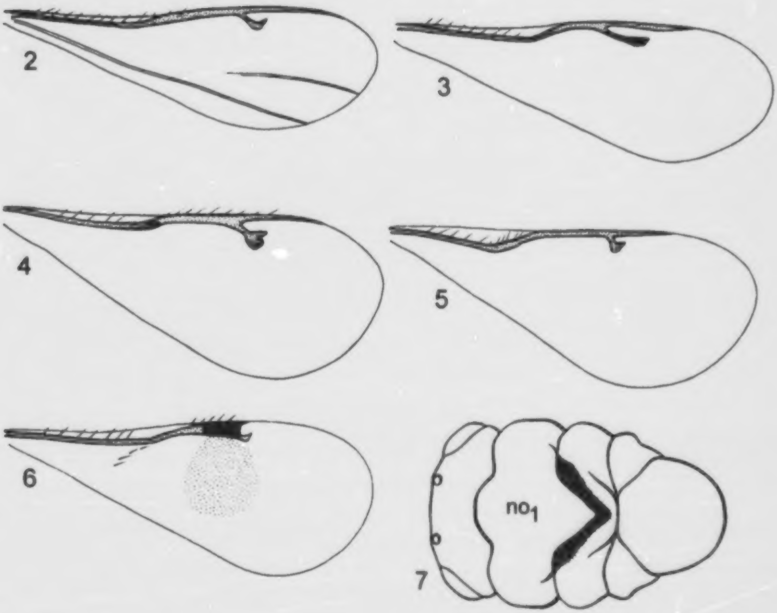


Fig. 1. ***Eurytoma*** ♀.



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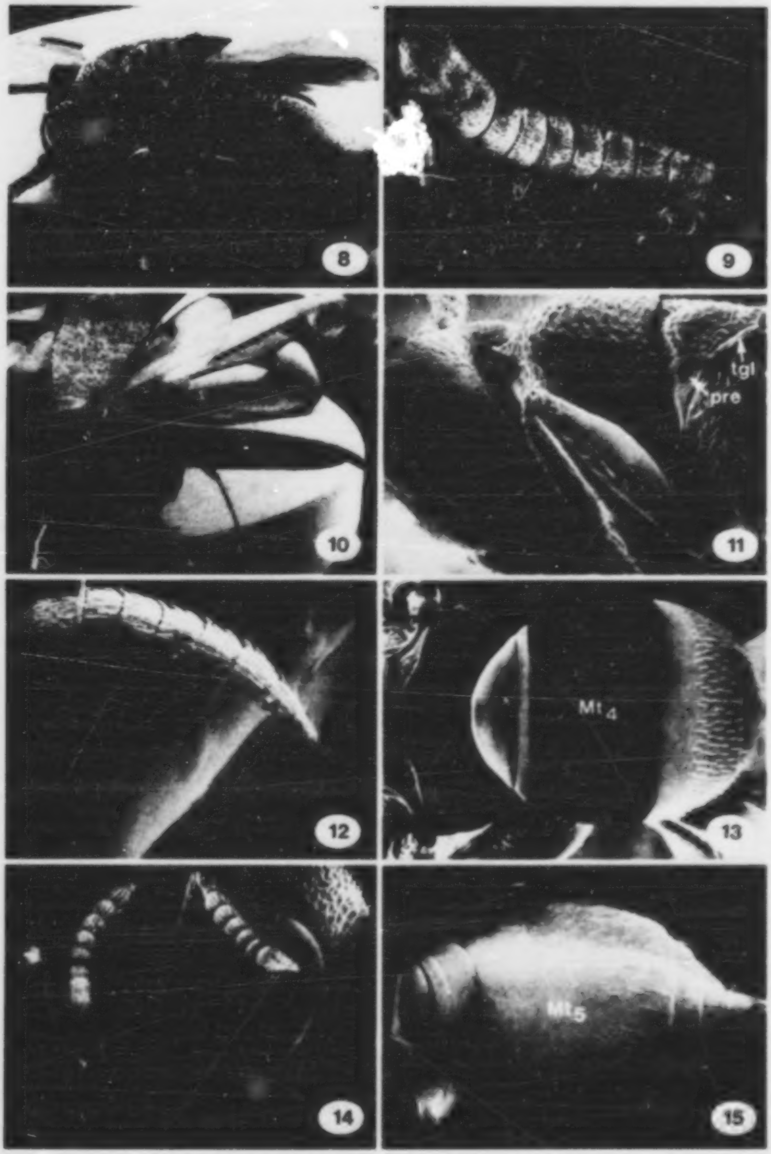
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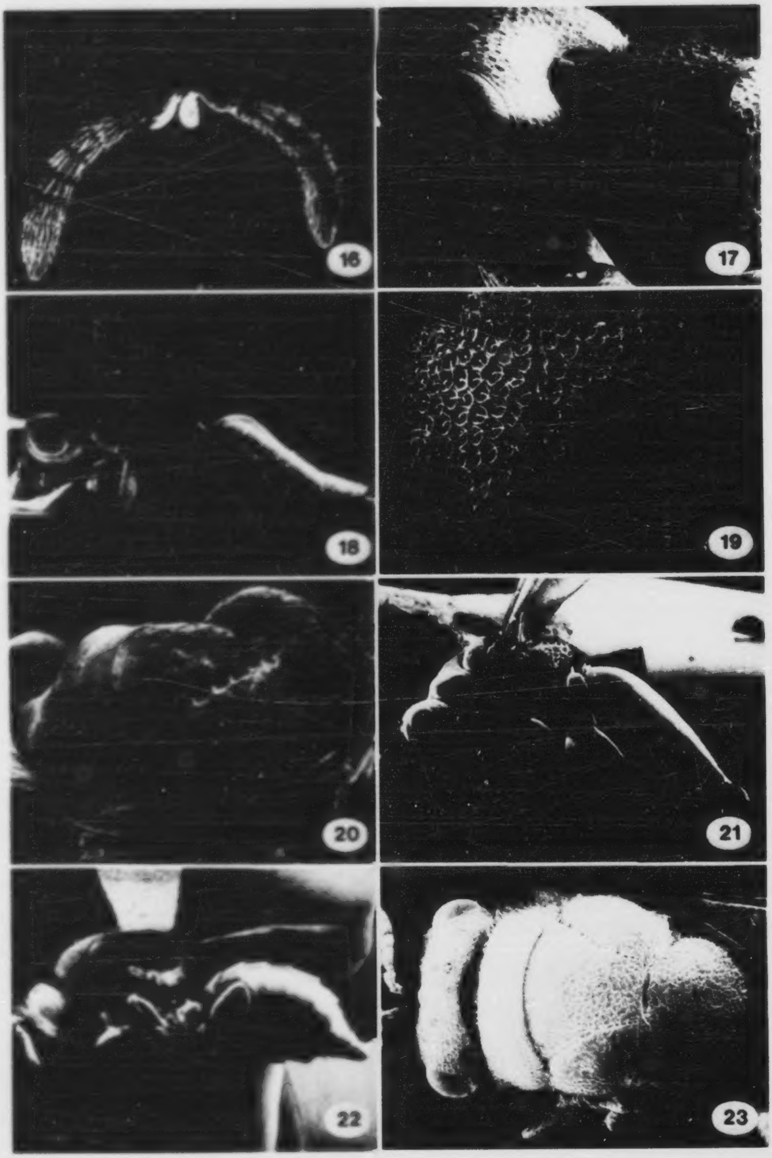

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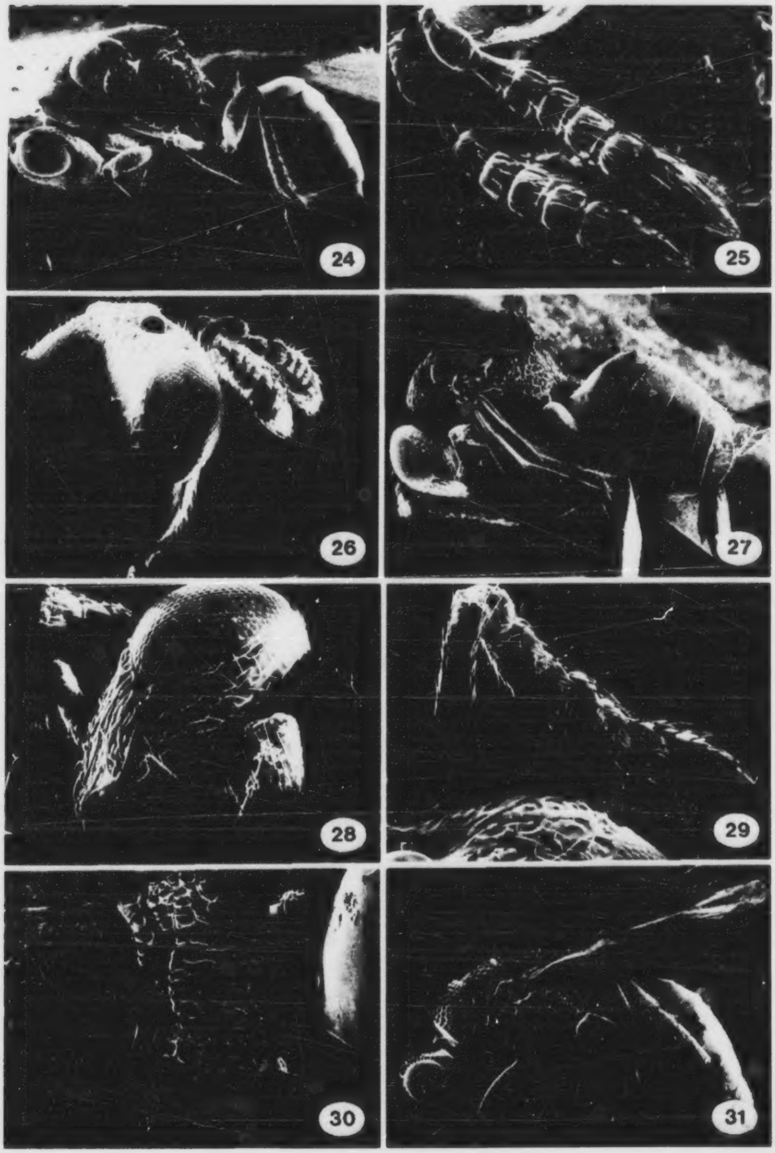
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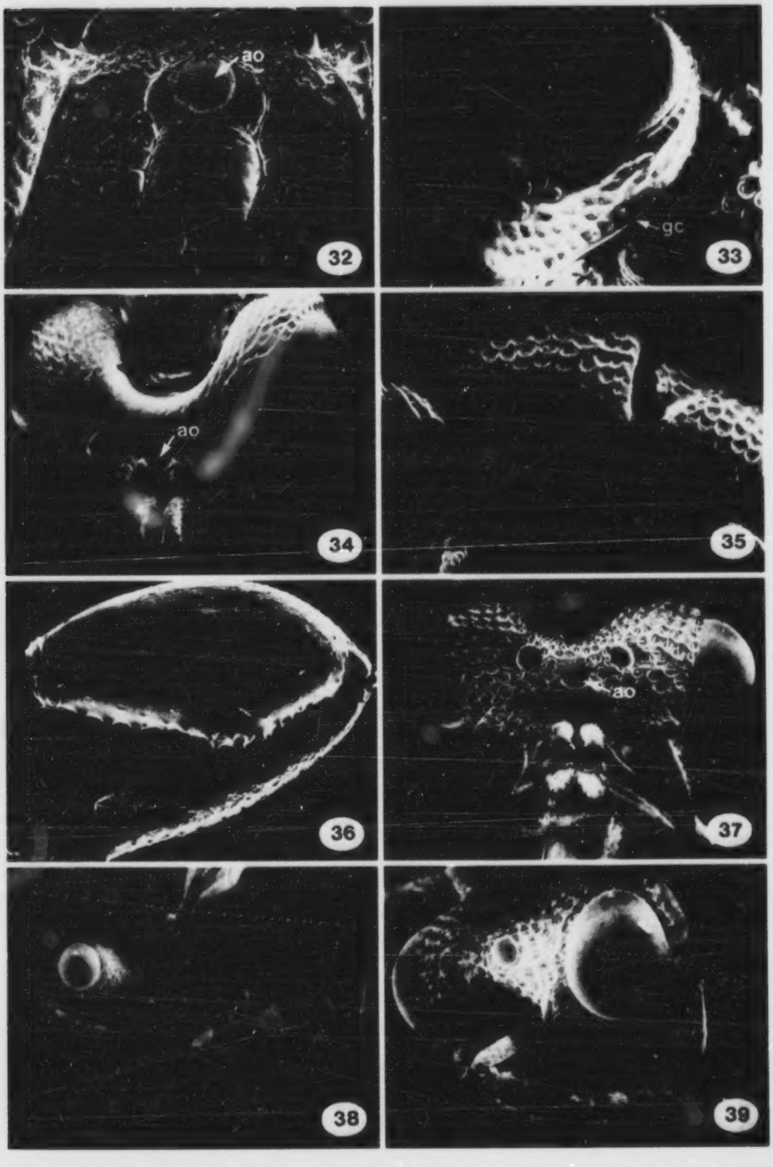
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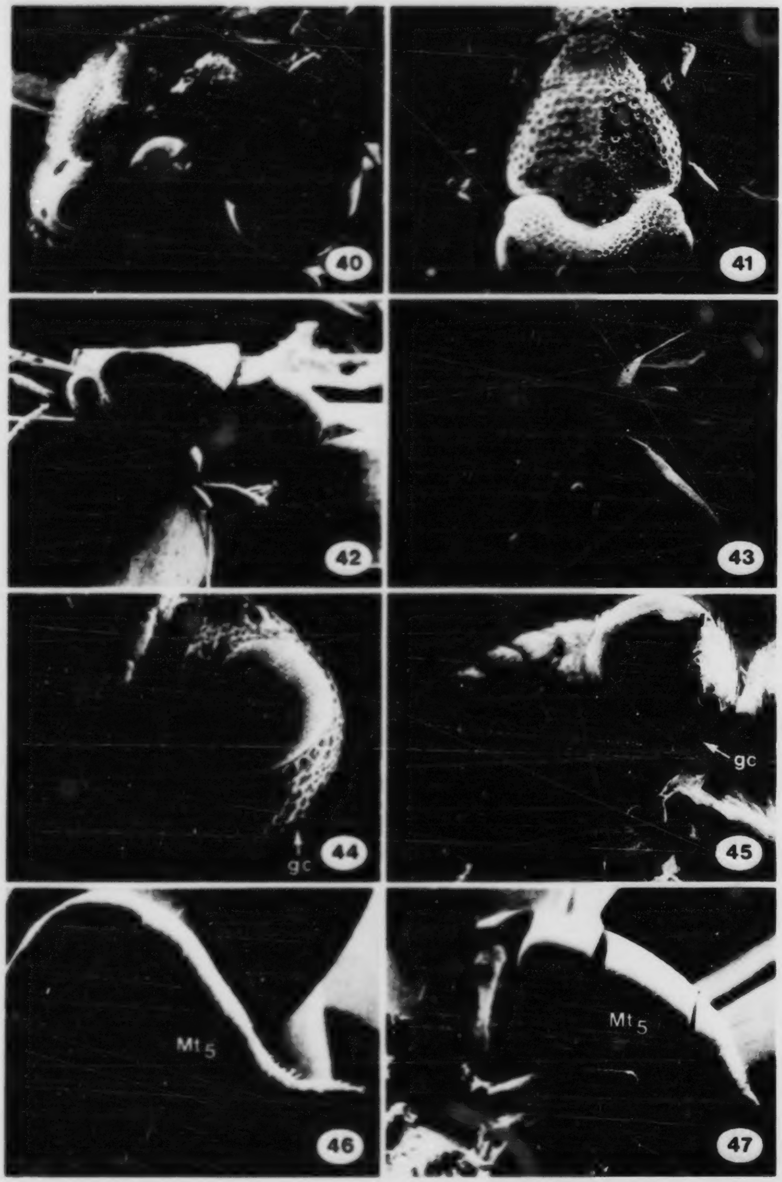
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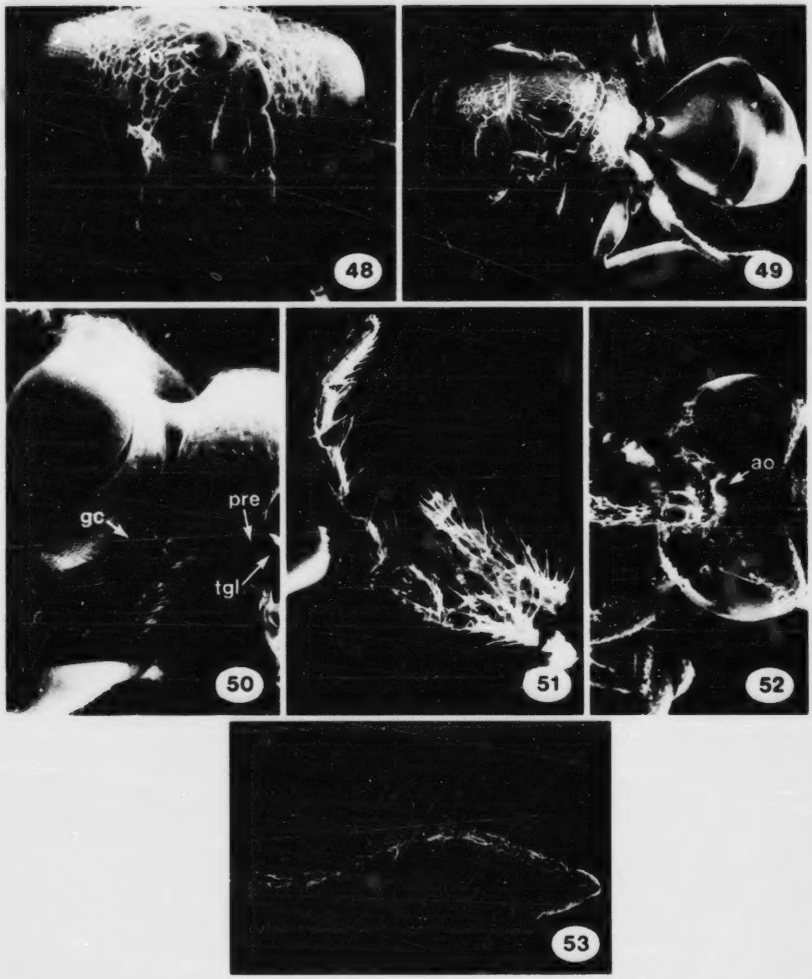
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Chapter 13. **LEUCOSPIDAE**

Zdenek Bouček

Recognition/Sysematics. Leucospidae are represented in the Nearctic region by only one genus, *Leucospis*, which is easily recognized by the following combination of features: forewing folded longitudinally (Fig. 3) (as in Vespidae); ovipositor sheaths turned upwards on dorsum of gaster (Fig. 1); and metafemur enlarged and bearing distinct teeth ventrally (Figs. 1, 2). Females of the strictly Neotropical *Polistomorpha* Westwood, the only other leucospid genus of the New World, have the ovipositor sheaths straight and horizontal, but both sexes of *Polistomorpha* are distinguished from *Leucospis* by presence of a tooth dorsomedially on the metacoxa and very reduced palpi (*Leucospis* with maxillary palpi 4-segmented and labial palpi 3-segmented).

Other characteristic features of Leucospidae include the following: body sturdy and covered by very coarse setiferous punctures; labrum concealed under produced clypeus; glossa long and labiomaxillary complex protruding; vestiges of parapsidal lines present lateral to the shallow notauli; venation rather unusual, as in Fig. 2; gaster broadly sessile, in females with interrupted pigmentation and with Gt_2 dorsally membranous and mostly concealed under Gt_1, in males with Gt_2 visible but the following terga fused into convex carapace. These features distinguish Leucospidae from Chalcididae, a closely related family with which they were often united in the past.

Fauna/Biology. Leucospidae are mainly a tropical group, as demonstrated by the fact that there are 16 species in Mexico, five in the USA, and only one in Canada. Leucospids are parasites of the larvae of various bees and wasps (Aculeata), in particular species nesting in hollow stems of plants or in burrows created by wood-boring Coleoptera, etc. in dead wood, less frequently on the ground under stones. The body patterns of different leucospid species mimic certain regionally dominant species of Vespidae, not their hosts.

Literature. Bouček (1974) revised the world fauna. Porter (1972) discussed the species of Florida and Burks (1979) cataloged the Nearctic species.

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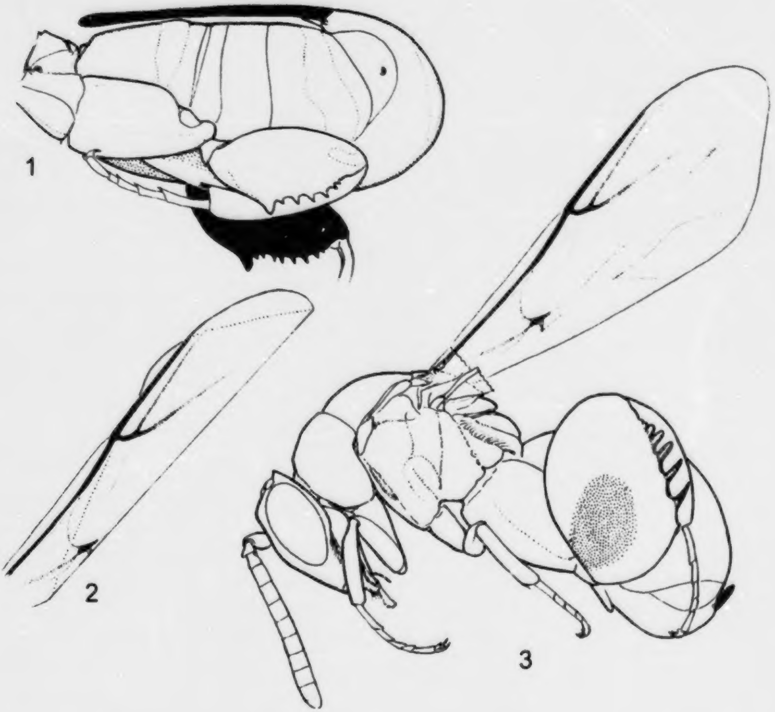

Figs. 1–3. 1, ***Leucospis affinis*** Say, ♀ metasoma and hind leg. 2–3, ***L. slossonae*** Weld: 2, folded forewing; 3, ♀.

Chapter 14. **MYMARIDAE**

John T. Huber

Recognition. Mymaridae are recognized by the following combination of derived features: head with dark bars of cuticle (trabeculae) and associated sutures on vertex and on face lateral to each torulus (Figs. 1–17); toruli almost always closer to eyes than to each other (Figs. 1–17); forewing almost always with a usually distinct, backwards projecting seta (hypochaeta) on ventral surface just in front of marginal vein; hind wing stalked, with membrane usually present (except in *Mymar*) but not extending to base (Fig. 91).

General features to recognize Nearctic mymarids include: minute to small (0.2–2.5 mm long; average 0.5–1.0 mm); black, brown, or yellow, without metallic sheen; usually fully winged, but sometimes short-winged or wingless, the fully winged forms with long marginal setae and with hind wing almost always very narrow and stalked basally (Fig. 91); antenna at least as long as head plus mesosoma, usually much longer, distinctly clavate in female and filiform in male. Because of their small size Mymaridae are most likely to be confused with Aphelinidae and Trichogrammatidae, but these only rarely have antennae as long as the head plus mesosoma.

Systematics. The higher classification of Mymaridae is unstable (Huber 1986). The previously proposed tribes and subfamilies need to be critically reviewed to take into account the diverse fauna of the Australian region. Noyes and Valentine (1989) proposed a preliminary grouping of genera based on their study of the New Zealand fauna.

Biology. Mymaridae are usually solitary, but sometimes gregarious parasites of insect eggs laid mostly in concealed situations, such as within plant tissue or in soil. Species whose immature stages have been observed within their host eggs have peculiar, mobile, mymariform first instar larvae; the remaining instars are sac-like and not mobile (Clausen 1940, Nénon et al. 1995).

From the relatively few reliable host records available it appears that mymarids are not species-specific. Many appear to be at least genus-specific and some species are known to parasitize hosts in several families of a single order. Hosts are recorded for members of about 24 world genera. About three-quarters of the host records are for the four largest and economically most important genera: *Gonatocerus*, *Polynema*, *Anaphes*, and *Anagrus*. Almost half of the host records are from Auchenorrhyncha (Homoptera); Hemiptera and Coleoptera are the next most important host orders. Other than Coleoptera, few holometabolous insects are parasitized. Huber (1986) provided a more complete host list for the world. The records summarized therein are not necessarily all correct because of the difficulty of reliably associating a parasite with its host egg and the problem of identifying host eggs to species — an egg usually has to be reared to adult for correct species identification.

Life histories are almost completely unknown except for a few species important in biological control. About 10 species of *Anaphes*, *Anagrus*, and *Polynema* have been used in classical biological control attempts against insect pests such as Curculionidae, Chrysomelidae, Cicadellidae, and Delphacidae. Considerable potential exists for using mymarids either in classical biological control or in inundative release programs (Jackson and Debolt 1987).

Fauna. Mymaridae are found in all terrestrial habitats from deserts to rainforests, and in ponds and marshes. Large numbers of individuals of many species often can be collected using Malaise or pan traps but because of their small size specimens are rarely seen and are difficult to study when alive. About 1,400 species have been described worldwide, classified in almost 100 genera. The greatest diversity of genera is in the southern Hemisphere, particularly Australia, New Zealand, and South America, and the largest number of species occurs in tropical forests. Most of the Nearctic genera are common to the Palaearctic region, but the Nearctic fauna is enriched by northern extensions of several Neotropical genera.

The Nearctic region has about 145 described species in 28 genera; a rough estimate of the total fauna is 200–250 species. Genera such as *Tetrapolynema* Ogloblin (1946), *Callodicopus* Ogloblin (1955), and *Hadromymar* Yoshimoto (1990) may eventually also be found in the region. Eastern North America, especially southeastern USA, appears to have the greatest diversity of genera and species. Relatively few genera occur in cold or arid areas of North America, the most common being *Anagrus*, *Anaphes*, *Gonatocerus* (mostly *litoralis* group), *Polynema*, and *Erythmelus*.

Literature. Apart from Annecke and Doutt's (1961) outdated key to world genera, other keys to genera include Yoshimoto (1990) for the Western Hemisphere, Noyes and Valentine (1989) for New Zealand, Schauff (1984) for the Holarctic Region, and Subba Rao and Hayat (1983) for the Indian subregion. Huber (1986) reviewed the literature on taxonomy and biology of the family. No species revision of the family exists for the Nearctic region though Girault (1929) keyed all the species known at that time; his key is difficult to use and very outdated. Burks (1979) cataloged the Nearctic species.

Use of key. For the purposes of this key the Nearctic region includes Mexico except for the lowland coastal areas and south of the gulf of Tehuantepec. Males of *Eustochus* and *Litus* are not keyed because they are unknown for Nearctic species, though they are known for European species. In the key, genera listed as widespread occur throughout the Nearctic region south of the northern limit of the boreal forest. Hosts recorded in the annotations include only those I consider to be correct.

In Mymaridae the scutellum often is divided into two distinct areas (Figs. 43–47), which are termed the anterior scutellum and posterior scutellum. The transverse trabecula rather than the anterior ocellus is treated as the dorsal limit of the face.

Key to genera of Mymaridae

1 Wings very short or absent 2
– Wings fully developed 4

2(1) Tarsi 4-segmented .... ***Cleruchus*** Enock, see 22
– Tarsi 5-segmented 3

3(2) Wings and ocelli absent .... ***Myrmecomymar*** Yoshimoto

Fauna: 1 sp., *M. masneri* Yoshimoto (1990), in eastern Canada and eastern USA (often in bogs).

– Wings and ocelli present .... ***Ooctonus*** Haliday, see 7

4(1) *Female*: flagellum distinctly clavate, the clava 1–3-segmented (Figs. 73–82) 5
– *Male*: flagellum filiform, at most with apical 2 flagellar segments more broadly joined together (Fig. 84) but otherwise similar to preceding segments (Figs. 83, 85–87) 31

5(4) Tarsi 5-segmented 6
– Tarsi 4-segmented 13

6(5) Funicle 8-segmented 7
– Funicle 5–7-segmented, the second segment sometimes minute, ring-like 8

7(6) Face with subantennal groove between torulus and margin of mouth (Fig. 1); pronotum divided medially, the two parts either abutting (Fig. 38) or separated by membranous area; propodeum smooth (Fig. 37) or with 2 longitudinal submedian carinae (Fig. 38); metasoma with petiole at most slightly longer than broad (Fig. 67) and in lateral view with Mt_2 at most only slightly longer than Mt_3 (Fig. 67) .... ***Gonatocerus*** Nees

Key: Huber (1988) (2 of 4 species groups). **Fauna**: 34 described and many undescribed spp., widespread. **Hosts**: mainly Cicadellidae and Membracidae (see Huber 1986).

– Face without subantennal grooves (Fig. 2); pronotum entire (Fig. 39); propodeum with diamond-like pattern of carinae (Fig. 39); metasoma with petiole at least twice as long as broad and in lateral view with Mt_2 distinctly longer than Mt_3 (Fig. 68) .... ***Ooctonus*** Haliday (part)

Key: Whittaker (1931). **Fauna**: at least 8 spp., widespread. **Hosts**: Cercopidae and Cicadellidae.

8(6) Forewing with venation much shorter than half length of wing 9

– Forewing with venation longer than half length of wing (Fig. 88) .... ***Arescon*** Walker

Fauna: 1 unidentified sp. in USA (FL) and Mexico. **Hosts**: unknown, but extralimital spp. on Cicadellidae.

9(8) Metasoma broadly joined to mesosoma (e.g., Fig. 62) 10

– Metasoma with short but distinct petiole (Fig. 64) .... ***Camptoptera*** Förster

Fauna: at least 3 spp., widespread. **Hosts**: Scolytidae (new record) and Buprestidae.

10(9) Funicle 7-segmented (Fig. 74) 11

– Funicle 5- or 6-segmented 12

11(10) Head in anterior view relatively long and narrow below eyes, together with ventrally directed mandibles giving head a beak-like appearance (Fig. 3); mandibles not crossed over, each with 1 pointed tooth and small inner tooth (Fig. 19) .... ***Dicopus*** Enock

Fauna: 3 described spp., widespread (Doutt 1974).

– Head in anterior view broader, not beak-like ventrally (Fig. 4); mandibles crossed over, each with 2 subequal teeth or with dorsal tooth slightly longer (Fig. 20) .... ***Dicopomorpha*** Ogloblin

Fauna: 1 described sp., *D. echmepterygis* Mockford (1997), and at least 3 undescribed spp., eastern.

12(10) Funicle 5-segmented or, if rarely 6-segmented, second segment minute and ring-like (Fig. 75); forewing basally with posterior margin usually distinctly incised (Fig. 89); metasoma weakly sclerotized, with Mt_2 similar to remaining segments (Fig. 63) .... ***Alaptus*** Westwood

Key: Girault (1929). **Fauna**: 7 spp., widespread. **Hosts**: Psocoptera.

– Funicle 6-segmented; forewing basally with posterior margin not incised (Fig. 90); metasoma strongly sclerotized, with Mt_2 the largest (Fig. 66) .... ***Litus*** Haliday

Fauna: 2 spp., the Holarctic *L. cynipseus* Haliday, and 1 undescribed sp., widespread. **Hosts**: Staphylinidae.

13(5) Funicle 8-segmented; propodeum and Mt_2 each with large, whitish, reticulate laminae (Figs. 40, 65); Mt_2 the largest tergum .... ***Ptilomymar*** Annecke & Doutt

Fauna: 2 spp., *P. magnificum* Yoshimoto in eastern Canada and USA (usually in bogs), and *P. rete* Annecke and Doutt (1961) in Mexico.

– Funicle 5- or 6-segmented; propodeum and Mt_2 without laminae; Mt_2 similar in size to subsequent terga 14

14(13) Metasoma usually relatively broadly joined to mesosoma (e.g., Fig. 60) (relatively narrowly in *Cleruchus*) (Fig. 59); petiole usually only slightly narrower than Mt_2 and ring-like, not longer than broad (Fig. 60) (sometimes not visible unless metasoma removed) 15

– Metasoma with petiole distinctly narrower than Mt_2, almost always much longer that broad (Figs. 70–72) but rarely (*Anagroidea*) only slightly longer than broad (Fig. 69) 23

15(14) Clava 2- or 3-segmented (Figs. 76–79) 16

– Clava 1-segmented 20

16(15) Clava 2-segmented (Figs. 76, 77) 17

– Clava 3-segmented (Figs. 78, 79) 18

17(16) Clava with apical finger-like projection (Fig. 76); scutellum entire or at most divided longitudinally in posterior half by faint median groove (Fig. 45); body mostly yellow or light brown; mandibles reduced, with apices not touching when closed (Fig. 22) .... ***Omyomymar*** Schauff

Key: Schauff (1983). **Fauna**: 3 spp., eastern.

– Clava without apical projection (Fig. 77); scutellum longitudinally divided by distinct median groove (Fig. 44); body dark brown except for whitish base of metasoma; mandibles normal, crossed over when closed (Fig. 5) ....***Schizophragma*** Ogloblin

Key: Huber (1987). **Fauna**: 2 spp. in USA (AZ, CA, FL, GA, OR, TX). **Hosts**: unknown, but extralimital spp. on Membracidae.

18(16) Funicle 5-segmented; forewing venation longer than half length of wing (Fig. 91) .... ***Krokella*** Huber

Fauna: 1 sp., *K. fera* Huber (1993), in USA (southern FL).

– Funicle 6-segmented; forewing venation much shorter than half length of wing (Figs. 92–94) 19

19(18) Clava compact, with segments appressed against one another and sutures between segments strongly oblique (Fig. 78); scutellum longitudinally divided by broad, shallow furrow (Fig. 46).......... .... ***Stethynium*** Enock

Key: Huber (1987). **Fauna**: 2 spp., mostly western (associated with *Salix* near water). **Hosts**: unknown, but extralimital spp. on Cicadellidae.

– Clava loose, with segments clearly separated from one another and sutures perpendicular to long axis of clava (Fig. 79); scutellum entire (Fig. 47) ....***Neostethynium*** Ogloblin

Fauna: 1 unidentified sp. in USA (MO, SC).

20(15) Metasoma with hypopygium long and conspicuous, much larger than preceding sterna (Fig. 61) .... ***Erythmelus*** Enock

Keys: Girault (1929) and Doutt (1949*a*). **Fauna**: 7 spp., widespread. **Hosts**: Miridae, Tingidae, and Cicadellidae.

– Metasoma with apical sternum relatively short, similar in size to preceding sterna (Fig. 62) 21

21(20) Forewing with 2 longitudinal hairless areas separated by row of setae extending from venation (Fig. 92); propodeum strongly sloping relative to scutellum (Fig. 33) and with median longitudinal groove (Fig. 41); body black or very dark brown .... ***Anaphes*** Haliday

Keys: Doutt (1949*b*) (as *Anaphoidea*) and Huber (1992) (1 of 2 species groups). **Fauna**: 19 described and many undescribed spp., widespread. **Hosts**: Curculionidae, Chrysomelidae, Miridae, Byrrhidae, and Ephydridae.

– Forewing uniformly setose beyond venation (Fig. 93) or with only few rows of setae (Fig. 94); propodeum in almost same plane as scutellum (Figs. 35, 36) and without median groove (Figs. 42, 43); body yellow, light brown or greyish 22

22(21) Scutellum clearly divided into anterior and posterior scutellum, the posterior scutellum longitudinally divided by groove (Fig. 43); forewing broadening apically (Fig. 93) .... ***Anagrus*** Haliday

Keys: Gordh and Dunbar (1977) and Chiappini et al. (1996). **Fauna**: 11 spp., widespread. **Hosts**: Cicadellidae, Cercopidae, Delphacidae, Miridae, Lestidae, and Coenagrionidae. (See Chiappini et al. 1996, Trjapitzin and Strong 1995, Trjapitzin 1995.)

– Scutellum undivided (Fig. 42); forewing parallel-sided, about as broad apically as basally (Fig. 94) .... ***Cleruchus*** Enock (part)

Fauna: 2 spp., widespread. **Hosts**: Curculionidae.

23(14) Head and mesosoma with strong, mostly reticulate sculpture (Figs. 7, 24, 55, 56) 24

– Head and mesosoma smooth, occasionally with faint sculpture (Figs. 8–12, 49–54) 26

24(23) Clava 2-segmented (Fig. 80) .... ***Eustochus*** Haliday

Fauna: 1 sp., *E. nearcticus* Yoshimoto (1990), in Canada (AB, BC, NS, ON) and USA (MD, MT, NC, WA).

– Clava 1-segmented 25

25(24) Flagellum elbowed between segments 2 and 3; funicle with first segment twice as long as second segment (Fig. 81); mandible narrow, directed ventrally, with 1 tooth and row of serrations (Fig. 7); petiole slightly longer than broad (Figs. 58, 69) .... ***Anagroidea*** Girault

Fauna: 1 sp., *A. boweni* Yoshimoto (1990), in USA (FL, GA, TX).

– Flagellum not elbowed; funicle with first segment not longer than second segment (Fig. 82); mandible broad, directed horizontally, with 3 equal, apical teeth (Fig. 24); petiole about twice as long as broad (Fig. 57) .... ***Caraphractus*** Walker

Fauna: 1 Holarctic aquatic sp., *C. cinctus* Walker, in Canada (MB, NB, ON, PQ) and USA (ME). **Hosts**: Dytiscidae.

26(23) Forewing oar-like, with basal half to two-thirds extremely narrow and apex suddenly broadened, with dark spot at apex and sometimes also at base of broadened area (Figs. 95, 96); torulus almost touching transverse trabecula (Figs. 8, 9) 27

– Forewing gradually broadening from base to apex (Fig. 97) and almost always without dark apical spot; torulus separated from transverse trabecula by at least half diameter of torulus (Figs. 10–12) 28

27(26) Scape about 7 times as long as broad (Fig. 31); hind wing stalk-like, without membrane and with only 1 apical seta .... ***Mymar*** Curtis

Key: Annecke (1960). **Fauna**: 2 spp., mainly eastern. **Hosts**: unknown, but extralimital spp. on Delphacidae and Cicadellidae.

– Scape about 4 times as long as broad (Fig. 32), hind wing normal, with membrane and numerous marginal setae .... ***Neomymar*** Crawford

Fauna: 1 described sp., *N. vierecki* Crawford, and several undescribed spp., eastern.

28(26) Metatibia with conspicuous, semierect setae at least 3 times as long as breadth of tibia (Fig. 18); body yellow to orange .... ***Cnecomymar*** Ogloblin

Fauna: 1 unidentified sp., eastern.

– Metatibia with setae relatively short and inconspicuous, mostly appressed, and not longer than breadth of tibia; body usually dark brown to black 29

29(28) Face dorsally strongly depressed between eyes (Fig. 11); vertex with large depression outside each ocellus (Fig. 15); propodeum smooth medially (Fig. 50); petiole apparently connected to Gs_1 (Fig. 72) .... ***Stephanodes*** Enock

Fauna: 1 described sp., *S. psecas* Girault, and 1 undescribed sp., widespread.

– Face dorsally not strongly depressed between eyes (Fig. 12); vertex without depression outside each ocellus (Fig. 16); propodeum usually with 1 or 2 longitudinal carinae medially (Figs. 53, 54), but sometimes smooth; petiole connected to Gt_1 (Fig. 71) 30

30(29) Forewing with some basally thickened setae, the setae usually on brown spots (Fig. 97) but scattered if forewing hyaline; propodeum with ∨-shaped carinae (Fig. 53) .... ***Acmopolynema*** Ogloblin

Key: Schauff (1981). **Fauna**: 7 spp., widespread. **Hosts**: Oecanthinae (Gryllidae), Cicadellidae, and Cercopidae.

– Forewing without thickened setae and usually without spots; propodeum with median carina (Fig. 54) or smooth .... ***Polynema*** Haliday

Key: Girault (1929). **Fauna**: 26 described and many undescribed spp., widespread. **Hosts**: Cicadellidae, Miridae, and Nabidae.

31(4) Tarsi 1-segmented; antenna consisting of 1 large, swollen segment; eyeless and wingless .... ***Dicopomorpha*** Ogloblin, see 11

– Tarsi 4- or 5-segmented; antenna normal, with scape and flagellum; eyes and usually wings present 32

32(31) Tarsi 5-segmented 33

– Tarsi 4-segmented 39

33(32) Flagellum 11-segmented, no segments ring-like 34

– Flagellum at most 10-segmented, sometimes with 1 or 2 ring-like segments (Figs. 85–87) 37

34(33) Forewing venation at most about one–third as long as wing (Figs. 89, 90, 92–97) 35

– Forewing venation longer than half length of wing (Figs. 88, 91) 36

35(34) Face with subantennal groove between torulus and mouth margin (Fig. 1); pronotum divided medially, the two parts either abutting (Figs. 37, 38) or separated by membranous area; propodeum smooth (Fig. 37) or with 2 longitudinal submedian carinae (Fig. 38); metasoma with petiole at most slightly longer than broad and in lateral view with Mt_2 at most only slightly longer than Mt_3 (Fig. 67) .... ***Gonatocerus*** Nees, see 7

– Face without subantennal grooves (Fig. 2); pronotum entire (Fig. 39); propodeum with diamond-like pattern of carinae (Fig. 39); metasoma with petiole at least 2 times longer than broad and in lateral view Mt_2 distinctly longer than Mt_3 (Fig. 68) .... ***Ooctonus*** Haliday, see 7

36(34) Antenna clearly longer than body and each flagellar segment at least 5 times as long as broad (Fig. 83); vertex without grooves enclosing ocellar triangle (Fig. 13) .... ***Myrmecomymar*** Yoshimoto, see 3

– Antenna not much longer than body and each flagellar segment at most about 3 times as long as broad (Fig. 84); vertex with grooves enclosing ocellar triangle (Fig. 14) .... ***Arescon*** Walker, see 8

37(33) Flagellum 10-segmented, with second and occasionally fourth segment small or ring-like (Fig. 85); forewing basally with posterior margin not excised 38

– Flagellum 8-segmented or, if rarely 9-segmented, second segment ring-like (Fig. 86); forewing basally with posterior margin distinctly excised (Fig. 89) .... ***Alaptus*** Westwood, see 12

Note: males of *Litus*, not yet recorded from the Nearctic region, would key out here; they have 9 flagellar segments, but the second segment is as long as the first, and the forewing is not excised behind the venation (Viggiani 1973).

38(37) Flagellum with second and sometimes fourth segment ring-like (Fig. 85); metasoma with short but distinct petiole (Fig. 64) .... ***Camptoptera*** Förster, see 9

– Flagellum with second segment at least as long as broad, about one-third length of remaining segments; metasoma broadly attached to mesosoma, without visible petiole (as in Fig. 63) .... ***Dicopus*** Enock, see 11

39(32) Metasoma with petiole not longer than broad and only slightly narrower than Mt_2, the metasoma often appearing broadly attached to mesosoma 40

– Metasoma with petiole at least slightly (Fig. 69) and almost always much longer (Figs. 57, 70–72) than broad, and distinctly narrower than Mt_2, the metasoma distinctly petiolate 50

40(39) Flagellum 10- or 11-segmented; mandible either normal in size and shape (Figs. 27, 28) or very small (Fig. 25) 41

– Flagellum 9-segmented; mandible massive, with long, curved, and serrate dorsal tooth (Fig. 26) .... ***Krokella*** Huber, see 18

41(40) Flagellum apparently 10-segmented (**Note**: first segment in *Anaphes* minute, easily overlooked, and therefore not counted.) (Fig. 87) 42

– Flagellum 11-segmented 43

42(41) Mandible with 3 teeth (Fig. 27); pronotum entire (Fig. 41); dorsellum well defined (Fig. 41); propodeum strongly sloping relative to scutellum (Fig. 33) and with median line (Fig. 41) .... ***Anaphes*** Haliday, see 21

– Mandible with 2 teeth (Fig. 28); pronotum divided medially (Fig. 42); dorsellum scarcely defined (Fig. 42); propodeum less strongly sloping relative to scutellum (Fig. 35) and without median line (Fig. 42) .... ***Cleruchus*** Enock, see 22

43(41) Scape with distinct spines on inner surface (Fig. 30) .... ***Omyomymar*** Schauff, see 17

– Scape without spines but often with more or less distinct sculpture on inner surface (Fig. 29) 44

44(43) Posterior scutellum completely divided by distinct longitudinal groove (Figs. 43, 44, 46) 45

– Posterior scutellum entire (Figs. 40, 42, 47, 48) 47

45(44) Face with subantennal groove extending from inner margin of torulus to mouth margin (Fig. 5); mandible with 4 teeth (Fig. 21); posterior scutellum distinctly longer than half its breadth (Figs. 44, 46) 46

– Face without subantennal groove (Fig. 6); mandible with 3 teeth (Fig. 23); posterior scutellum about as long as half its breadth (Fig. 43) .... ***Anagrus*** Haliday, see 22

46(45) Scutellum brown .... ***Schizophragma*** Ogloblin, see 17

– Scutellum pale yellow .... ***Stethynium*** Enock, see 19

47(44) Propodeum and Mt$_2$ with large, whitish, reticulate laminae (Figs. 40, 65) .... ***Ptilomymar*** Annecke & Doutt, see 13

– Propodeum and Mt$_2$ without laminae 48

48(47) Mandible a minute stub without teeth (Fig. 25); dorsellum distinct, projecting slightly as small triangular lobe over propodeum (Figs. 34, 48) .... ***Erythmelus*** Enock, see 20

– Mandible not reduced, with at least 2 teeth; dorsellum not visible (Fig. 42) or faint and band-like, but not projecting over propodeum (Fig. 47) 49

49(48) Mandible with 2 teeth (Fig. 28); pronotum divided medially (Fig. 42) .... ***Cleruchus*** Enock, see 22

– Mandible with at least 3 teeth; pronotum entire (Fig. 47) .... ***Neostethynium*** Ogloblin, see 19

50(39) Head and mesosoma covered with distinct, reticulate sculpture (Figs. 7, 24, 55, 56) 51

– Head and mesosoma at most faintly sculptured, often smooth (Figs. 8–12, 49–54) 52

51(50) Flagellum 10-segmented; mandibles broad and crossed when closed, with 3 subequal teeth (Fig. 24) .... ***Caraphractus*** Walker, see 25

– Flagellum 11-segmented; mandibles narrow and directed ventrally, with 1 tooth and row of serrations (Fig. 7) .... ***Anagroidea*** Girault, see 25

52(50) Face dorsally strongly depressed between eyes (Fig. 11); vertex with large depression outside each ocellus (Fig. 15) .... ***Stephanodes*** Enock, see 29

– Face dorsally not depressed between eyes (Figs. 8–10, 12); vertex usually flat (Figs. 16, 17), at most with small depression (not broader or longer than ocellus) outside each ocellus 53

53(52) Forewing oar-like, with basal half to two-thirds extremely narrow and apex suddenly broadened; forewing with apex and sometimes also base of broadened area with dark spot (Figs. 95, 96); torulus almost touching transverse trabecula (Figs. 8, 9) 54

– Forewing gradually broadening from base to apex (Fig. 97) and almost always without dark apical spot, though dark transverse subapical band sometimes present; torulus separated from transverse trabecula by at least half diameter of torulus (Figs. 10, 12) 55

54(53) Scape about 2 times as long as broad ..... ***Neomymar*** Crawford, see 27
– Scape about 7 times as long as broad ..... ***Mymar*** Curtis, see 27

55(53) Propodeum medially with ∨ -shaped carinae (Fig. 53); forewing with some thickened setae on disc and almost always with 1 or 2 distinct, transverse, dark-colored areas (Fig. 97) ..... ***Acmopolynema*** Ogloblin, see 30
– Propodeum smooth or at most with median carina; forewing without thickened setae and usually without dark-colored areas 56

56(55) Body orange to yellow, occasionally light brown; propodeum smooth, without median carina (Fig. 49); metatibia with prominent, semierect setae at least 3 times as long as width of tibia (Fig. 18) ..... ***Cnecomymar*** Ogloblin, see 28
– Body dark brown to black, at most petiole yellow; propodeum with median carina (Fig. 54), the carina sometimes very short; metatibia with inconspicuous, subappressed setae, the setae at most about as long as width of tibia ..... ***Polynema*** Haliday, see 30

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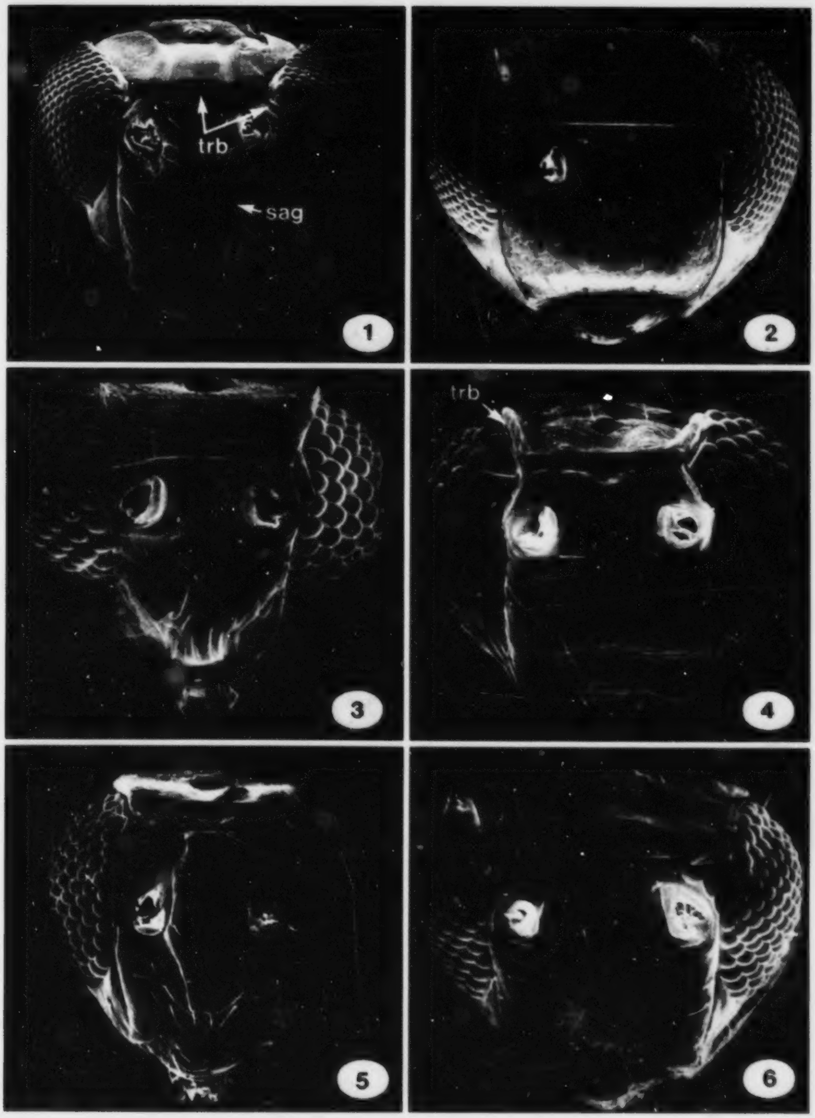
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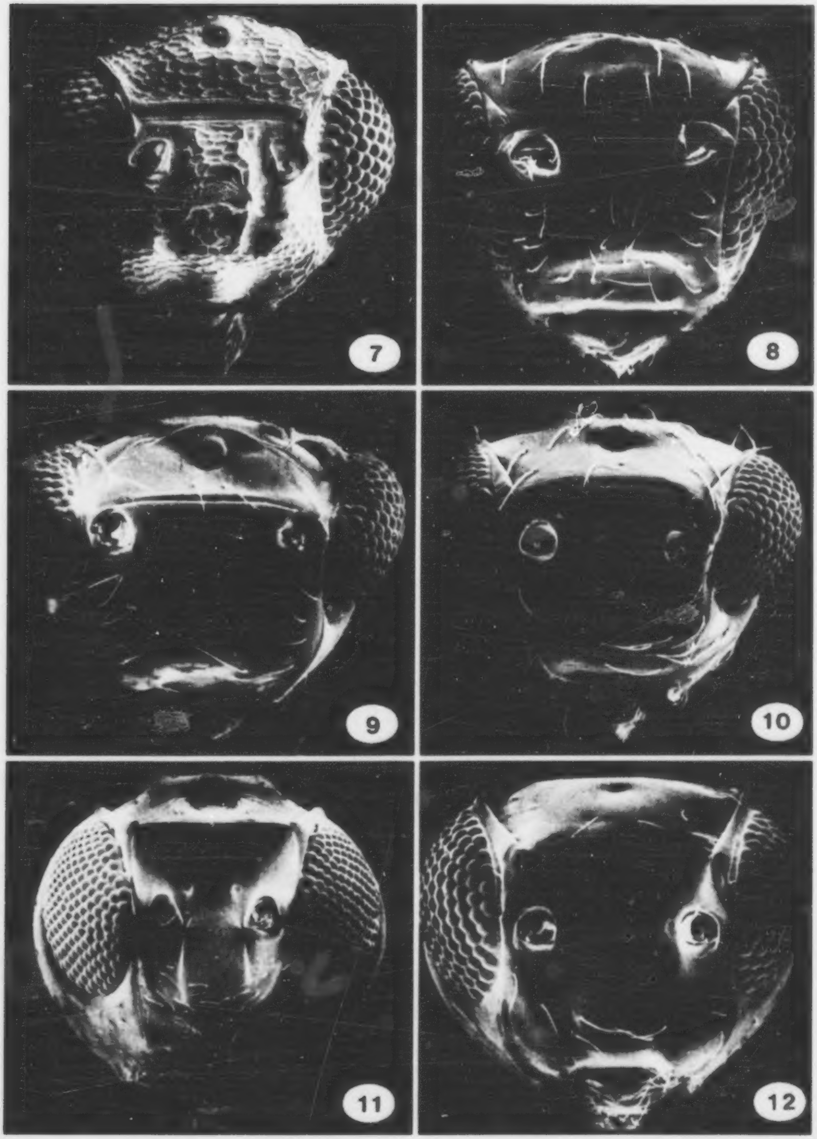
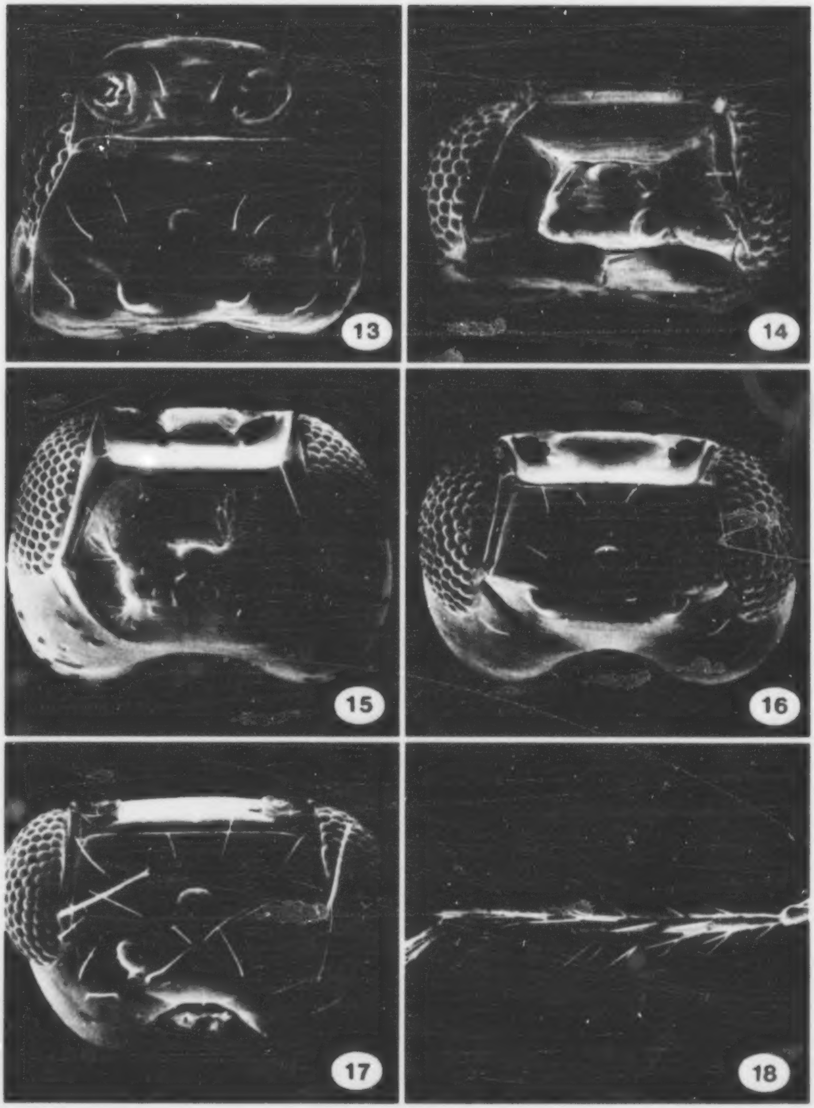
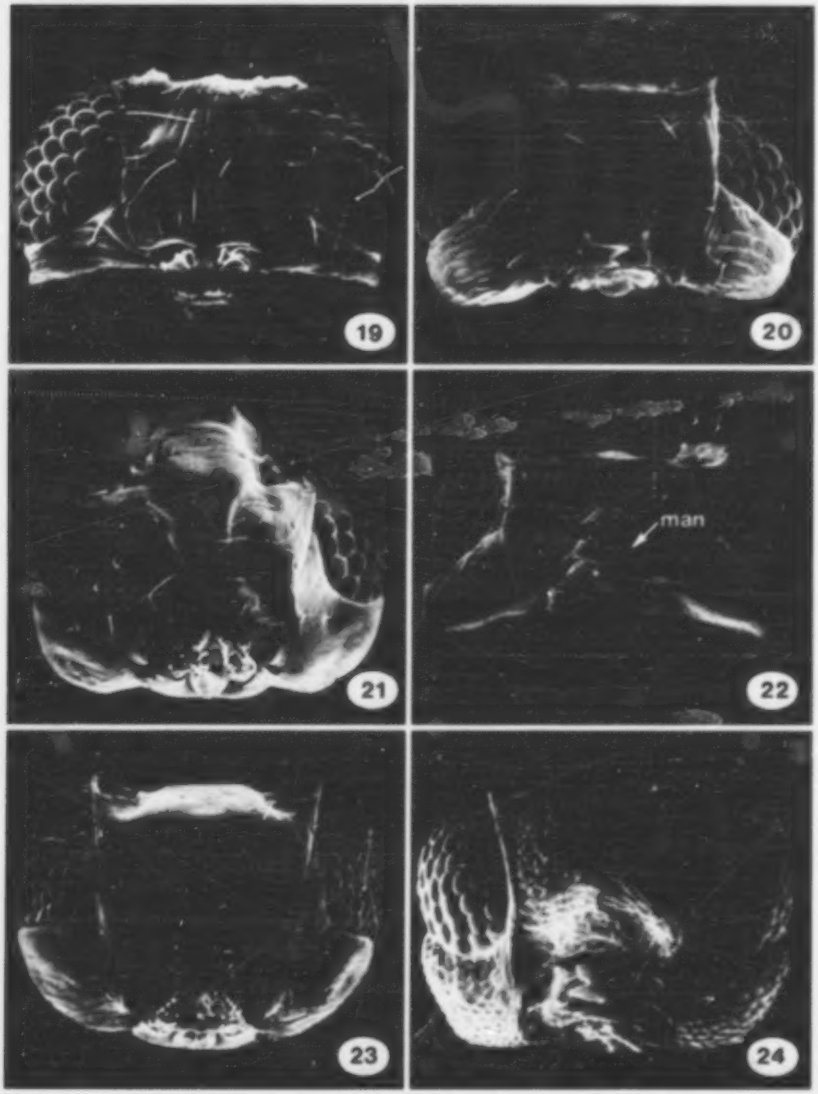
Figs. 1–6. Head: 1, ***Gonatocerus litoralis*** group; 2, ***Ooctonus***; 3, ***Dicopus***; 4, ***Dicopomorpha***; 5, ***Schizophragma bicolor*** (Dozier); 6, ***Anagrus***.



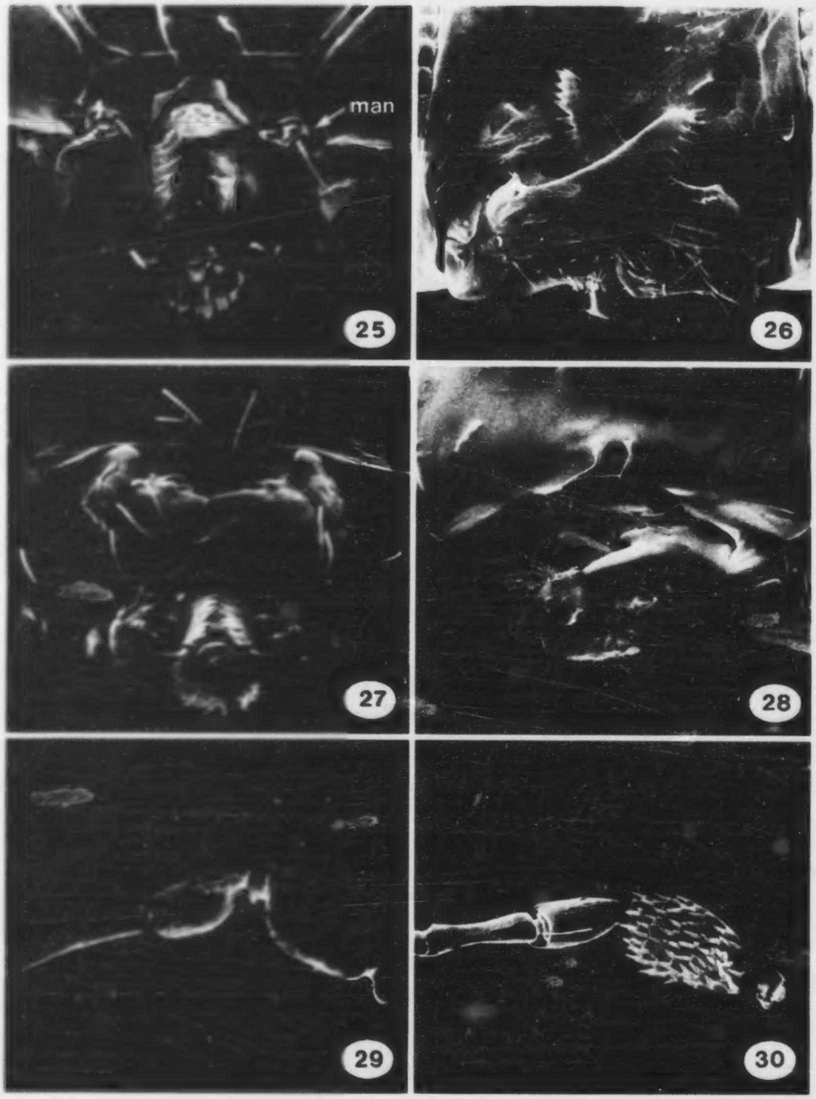
Figs. 7–12. Head: 7, ***Anagroidea***; 8, ***Mymar***; 9, ***Neomymar***; 10, ***Cnecomymar***; 11, ***Stephanodes***; 12, ***Polynema***.



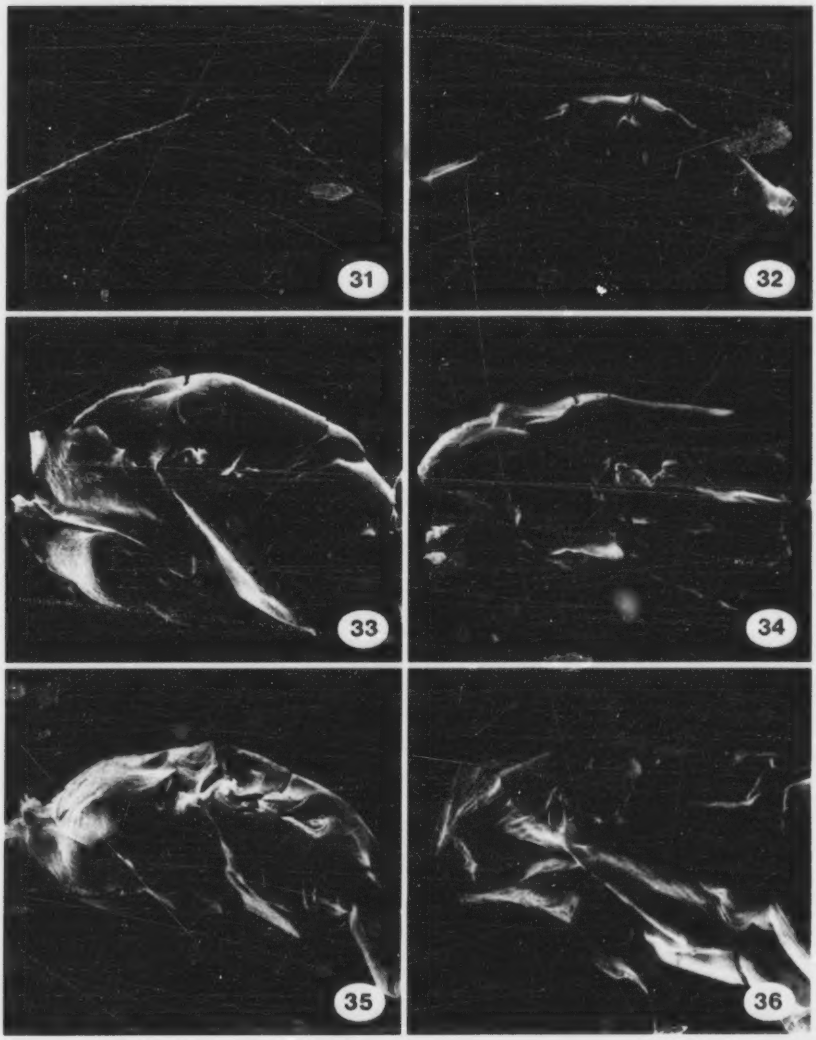
Figs. 13–18. 13–17, head (dorsal): 13, ***Myrmecomymar*** ♂; 14, ***Arescon***; 15, ***Stephanodes***; 16, ***Polynema***; 17, ***Neomymar***. 18, ***Cnecomymar***, metatibia (lateral).



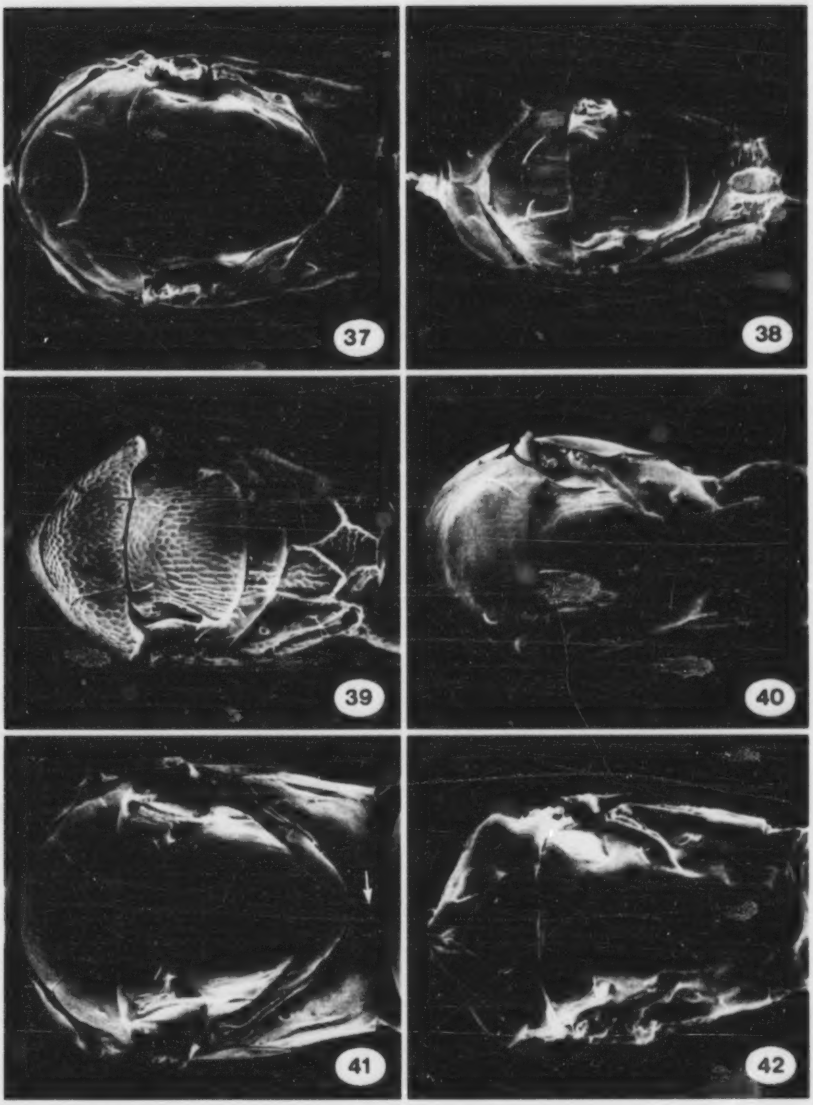
Figs. 19–24. Head (ventral): 19, ***Dicopus***; 20, ***Dicopomorpha***; 21, ***Schizophragma bicolor*** (Dozier); 22, ***Omyomymar*** ♀; 23, ***Anagrus***; 24, ***Caraphractus cinctus*** Walker.



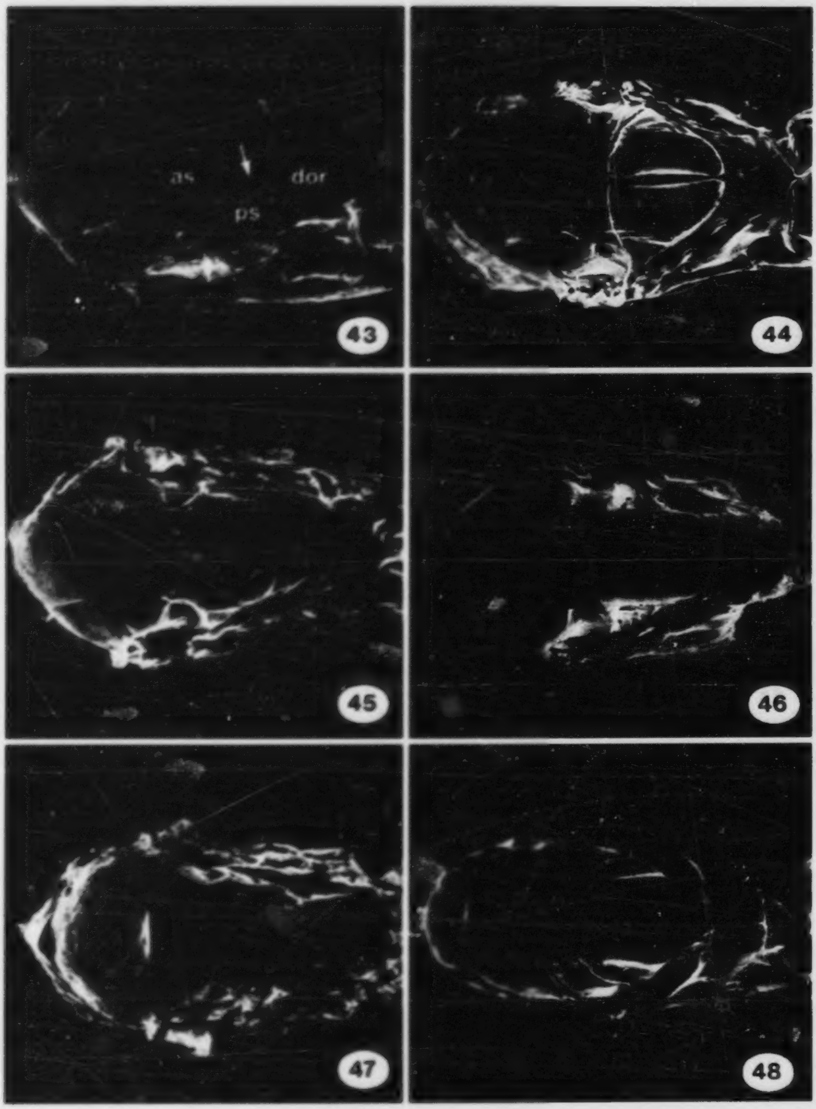
Figs. 25–30. 25–28, mouthparts: 25; ***Erythmelus*** ♂; 26, ***Krokella*** ♂; 27, ***Anaphes***; 28, ***Cleruchus***. 29–30, scape–first flagellar segment (inner surface): 29, ***Stephanodes***; 30, ***Omyomymar*** ♂.



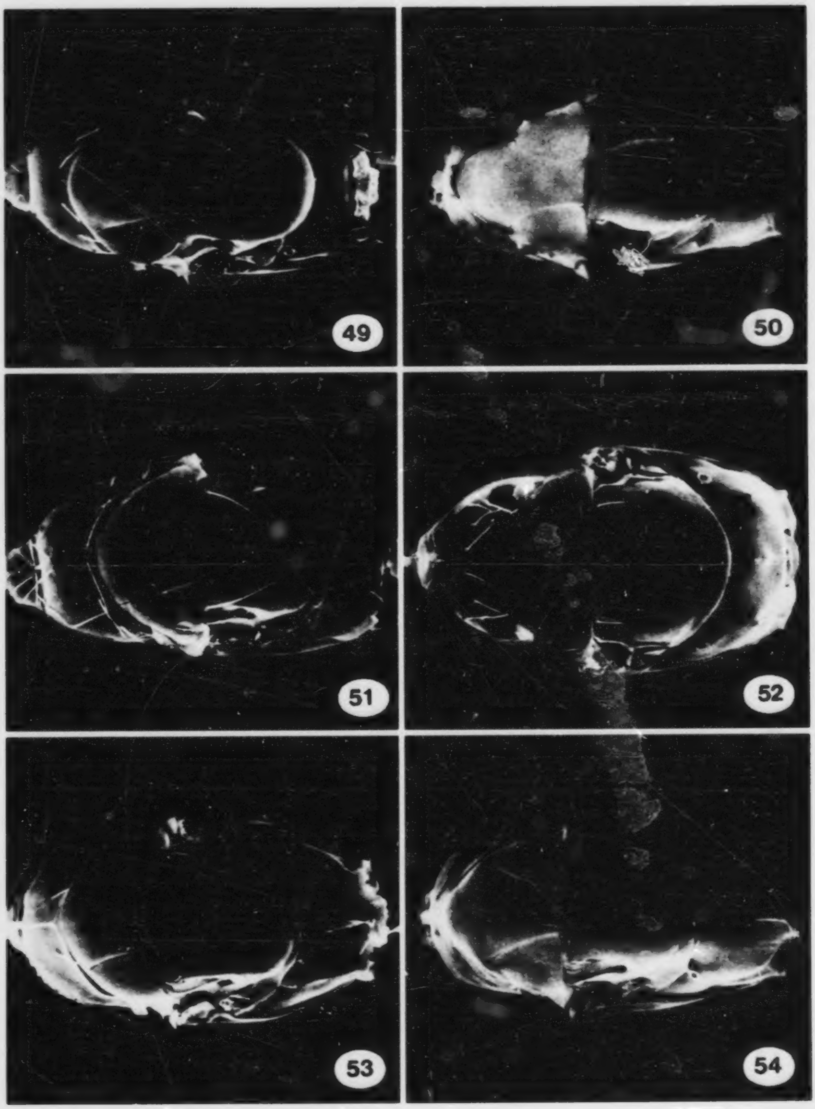
Figs. 31–36. 31–32, scape–first flagellar segment (inner surface): 31, ***Mymar***; 32, ***Neomymar***. 33–36, metasoma (lateral): 33, ***Anaphes***; 34, ***Erythmelus***; 35, ***Cleruchus***; 36, ***Anagrus***.



Figs. 37–42. Mesosoma: 37, ***Gonatocerus rivalis*** Girault; 38, ***Gonatocerus*** near ***morrilli***; 39, ***Ooctonus***; 40, ***Ptilomymar magnificum*** Yoshimoto; 41, ***Anaphes***; 42, ***Cleruchus***.



Figs. 43–48. Mesosoma: 43, ***Anagrus*** (arrow points to groove); 44, ***Schizophragma bicolor*** (Dozier); 45, ***Omyomymar***; 46, ***Stethynium triclavatum*** Enock; 47, ***Neostethynium***; 48, ***Erythmelus psallidis*** Gahan.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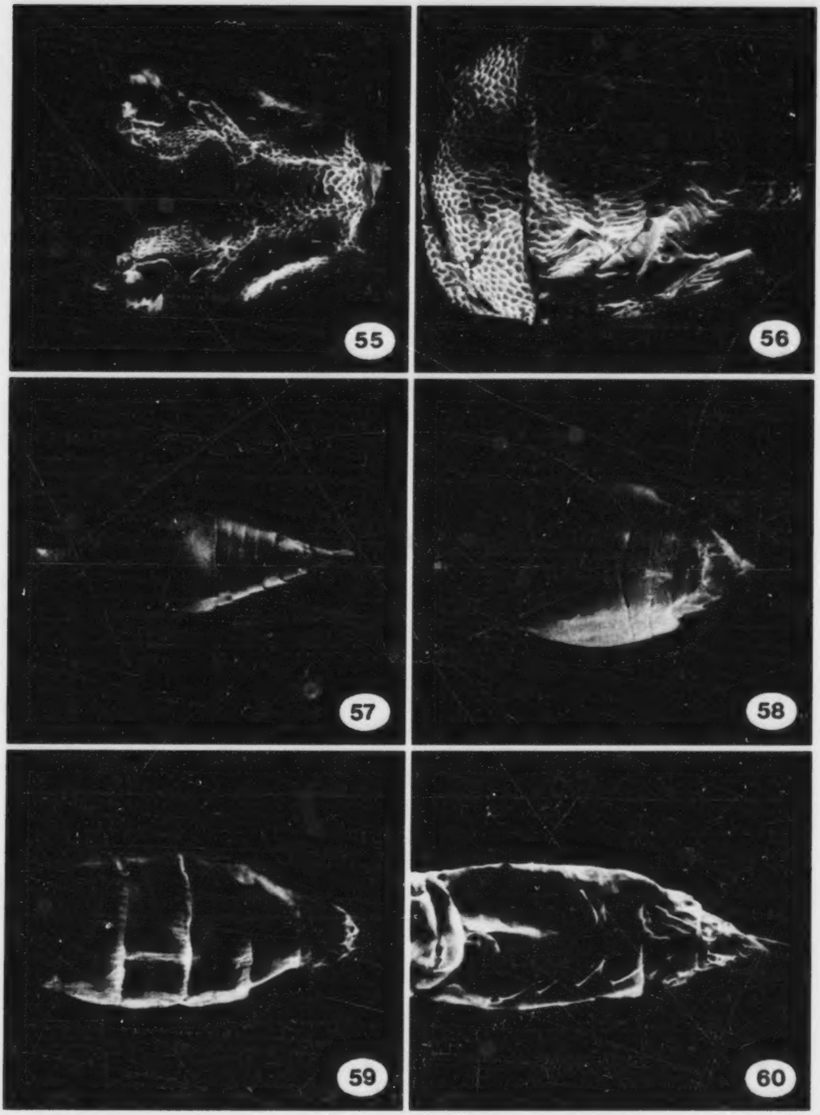
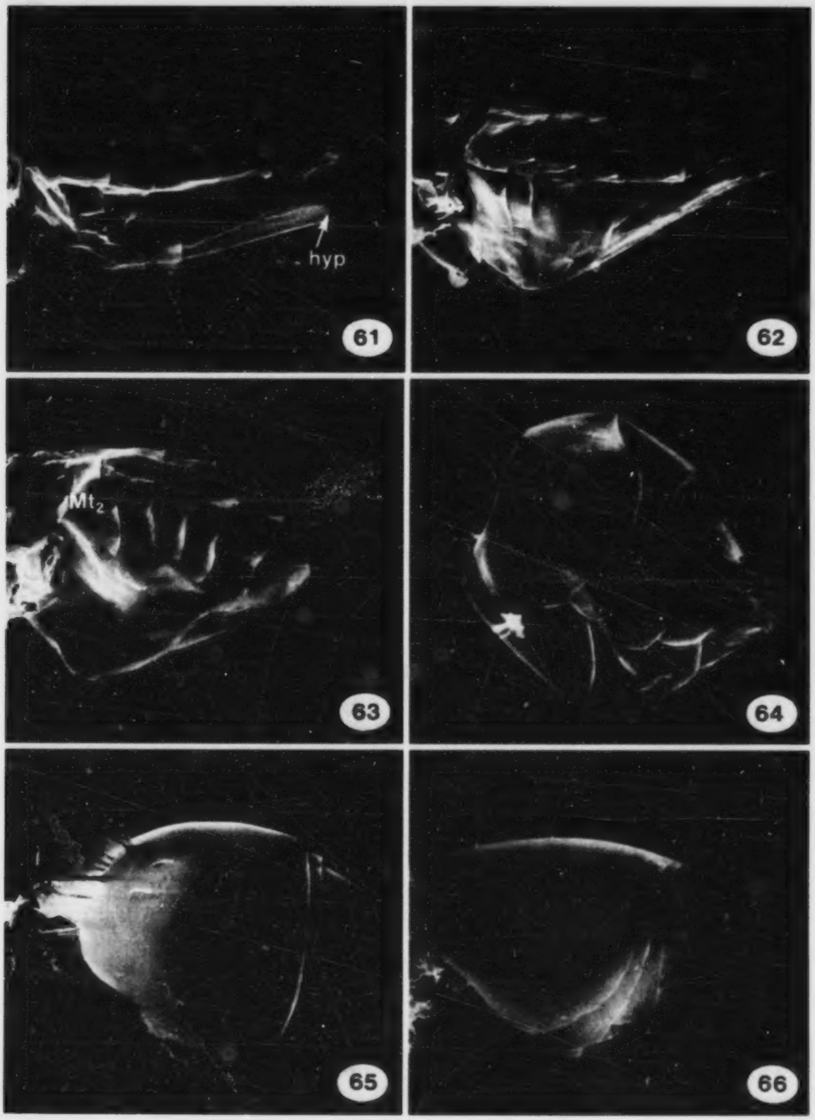
Figs. 49–54. Mesosoma: 49, ***Cnecomymar***; 50, ***Stephanodes***; 51, ***Neomymar***; 52, ***Mymar***; 53, ***Acmopolynema***; 54, ***Polynema***.



Figs. 55–60. 55–56, ♀ mesosoma: 55, ***Caraphractus cinctus*** Walker; 56, ***Anagroidea***. 57–60, ♀ metasoma: 57, ***C. cinctus*** Walker; 58, ***Anagroidea***; 59, ***Cleruchus***; 60, ***Anagrus***.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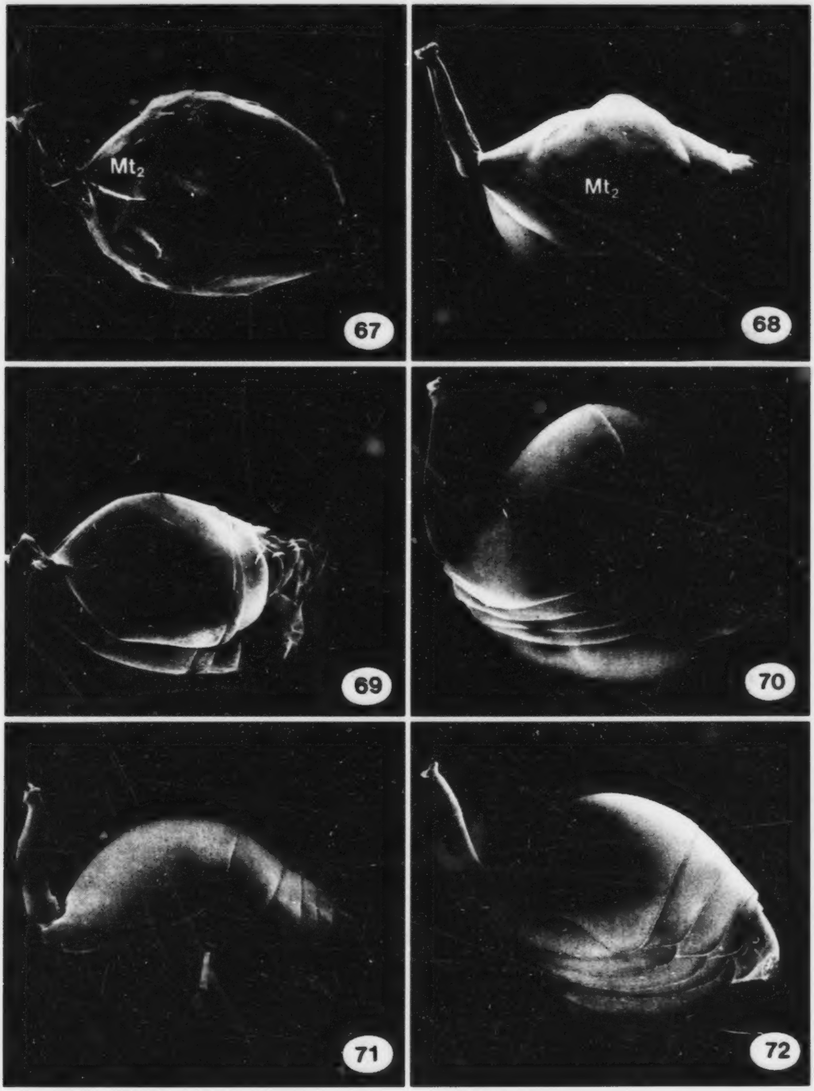
Figs. 61–66. ♀ metasoma (lateral): 61, ***Erythmelus psallidis*** Gahan; 62, ***Anagrus***; 63, ***Alaptus***; 64, ***Camptoptera***; 65, ***Ptilomymar magnificum*** Yoshimoto; 66, ***Litus cynipseus*** Haliday.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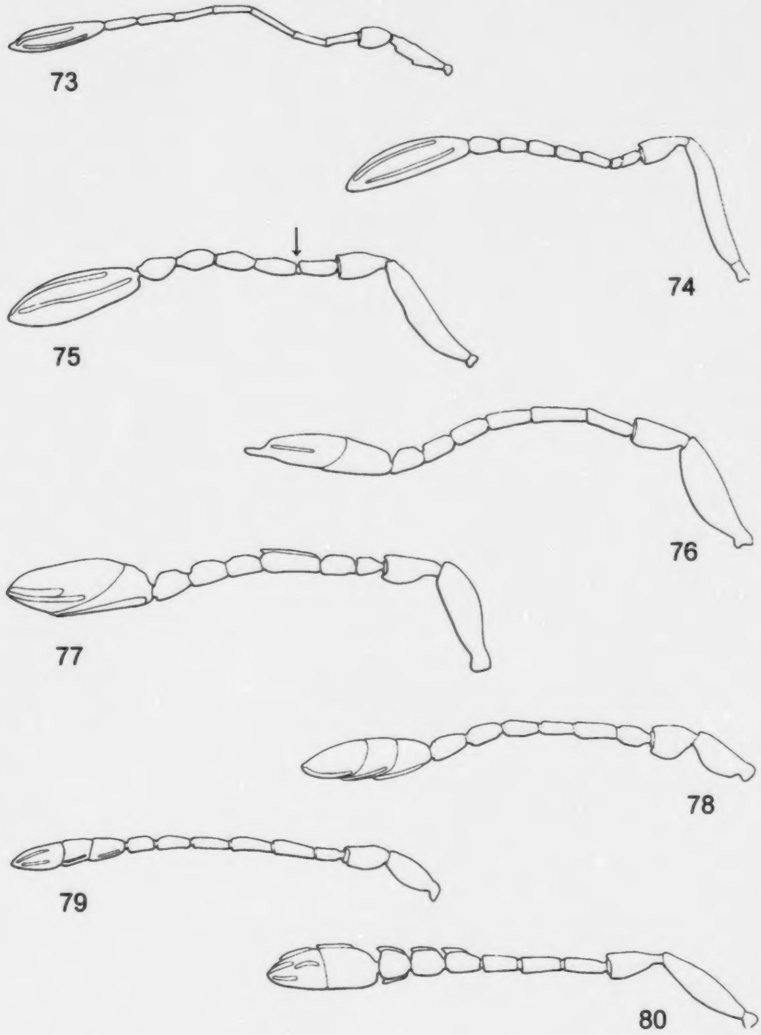
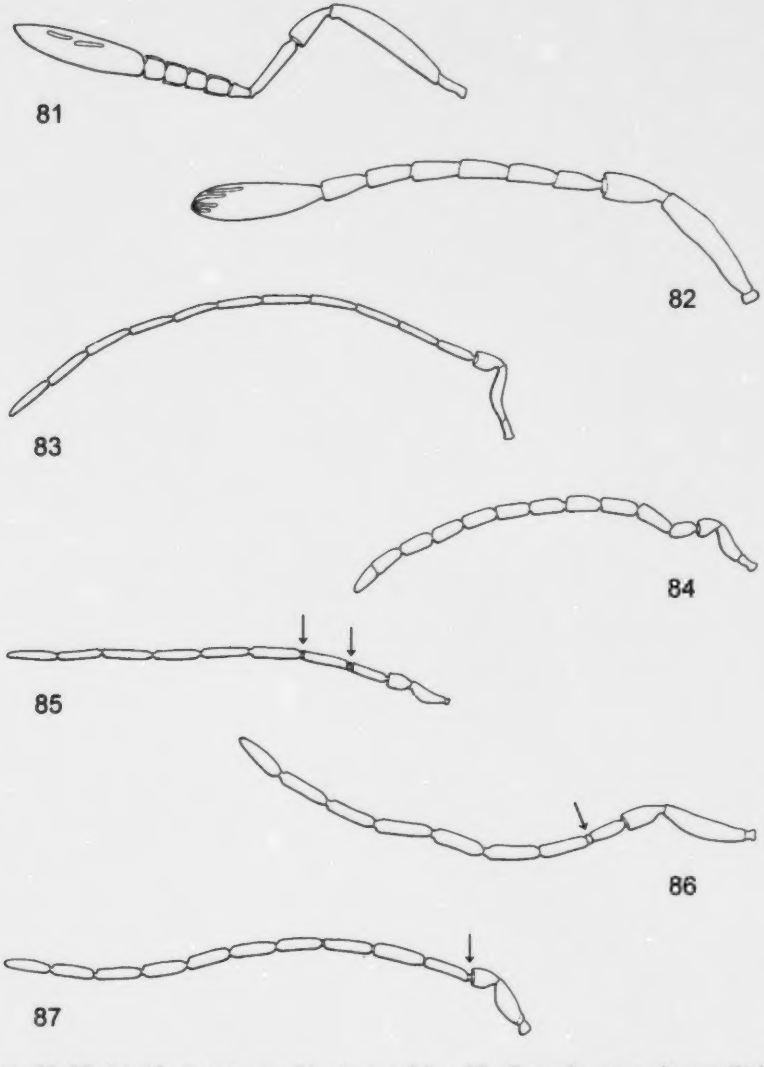
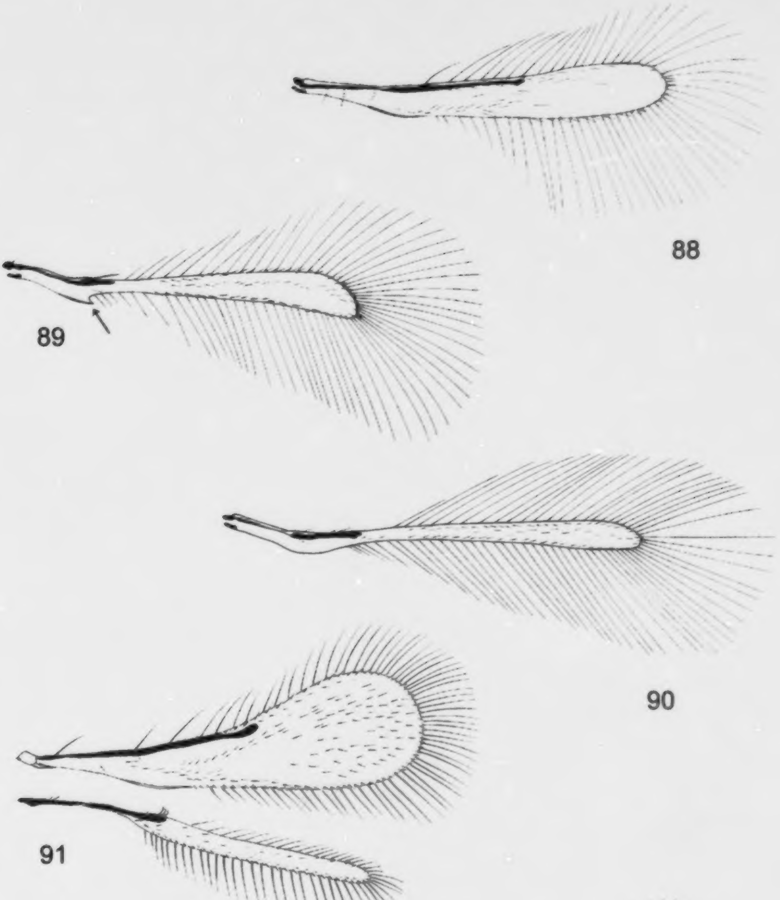
Figs. 67–72. ♀ metasoma (lateral): 67, ***Gonatocerus*** near ***morrilli***; 68, ***Ooctonus***; 69, ***Anagroidea***; 70, ***Mymar***; 71, ***Acmopolynema***; 72, ***Stephanodes***.



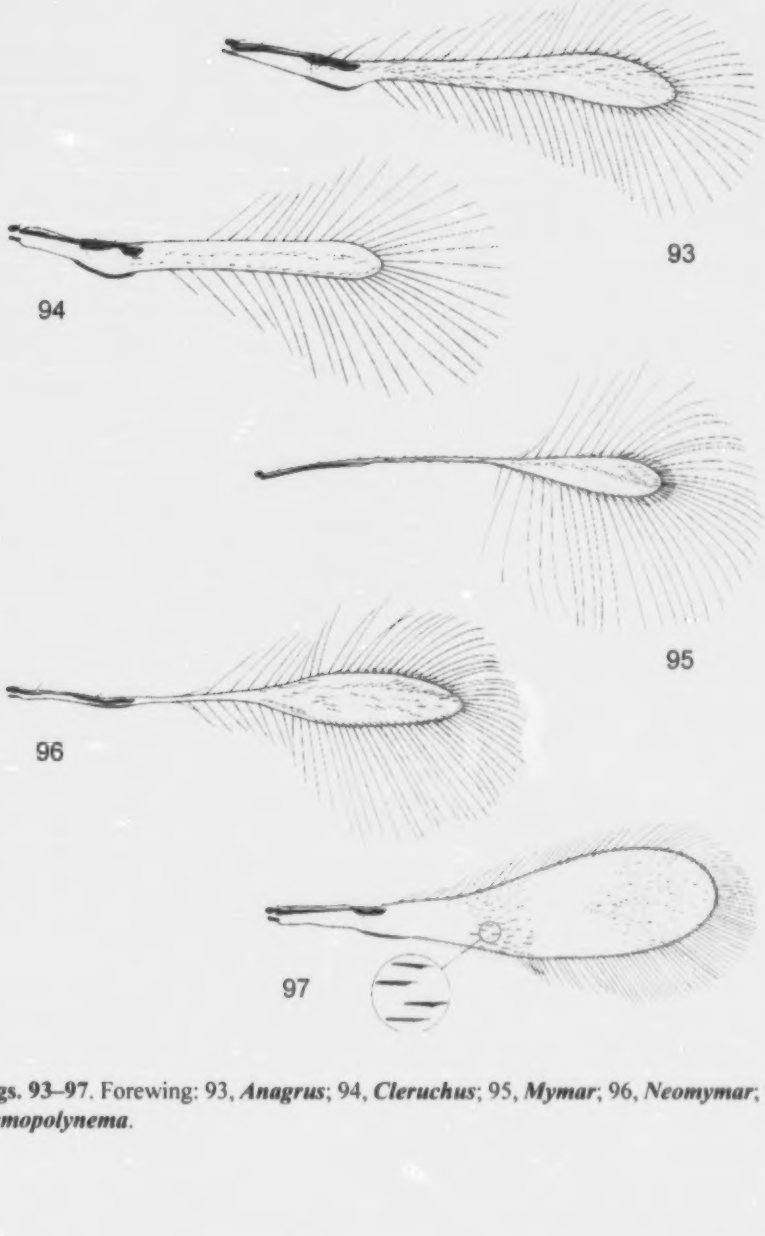
Figs. 73–80. ♀ antenna: 73, ***Dicopus***; 74, ***Dicopomorpha***; 75, ***Alaptus*** (arrow points to ring-like segment); 76, ***Omyomymar***; 77, ***Schizophragma***; 78, ***Stethynium triclavatum*** Enock; 79, ***Neostethynium***; 80, ***Eustochus***.



Figs. 81–87. 81–82, ♀ antenna: 81, ***Anagroidea***; 82, ***Caraphractus cinctus*** Walker. 83–87, ♂ antenna: 83, ***Myrmecomymar***; 84, ***Arescon***; 85, ***Camptoptera***; 86, ***Alaptus***; 87, ***Anaphes***. (Arrows point to ring-like segments).



Figs. 88–92. Forewing: 88, ***Arescon***; 89, ***Alaptus*** (arrow points to incised margin); 90, ***Litus cynipseus*** Haliday; 91, ***Krokella fera*** Huber (including hind wing); 92, ***Anaphes***.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Figs. 93–97. Forewing: 93, ***Anagrus***; 94, ***Cleruchus***; 95, ***Mymar***; 96, ***Neomymar***; 97, ***Acmopolynema***.

Chapter 15. **ORMYRIDAE**

Paul Hanson

Recognition. Ormyridae are recognized by the structure of their metasoma. The middle terga have transverse rows of large pits anteriorly on each tergum (Figs. 1, 3, 4), with the pits usually separated from the less heavily sculptured posterior part of the tergum by a crenulate border (Fig. 3). In some specimens the pits are concealed by the preceding tergum and in a few extralimital species the pits are absent. Though less conspicuous, a better synapomorphy for the family may be that the metatibia has two stout, curved apical spurs (Fig. 6). Members of other families have one or two straight, more slender metatibial spurs. Other important diagnostic features include: head with occipital carina (Fig. 2); mesosoma weakly sculptured with mesoscutum usually imbricate-striate (Fig. 5); notauli shallow or absent (Fig. 5); forewing with stigmal and postmarginal veins very short; metacoxa enlarged (Fig. 1) and triangular in cross-section; and metasoma with Mt_1 (petiole) usually not visible and Mt_3 largely concealed by Mt_2 (Figs. 1, 4). The number of anelli varies from 1–3, with 2 anelli being most common. Nearctic species are mostly metallic blue or green, although some specimens are yellowish-brown. Females have procumbent white setae (Figs. 3, 5), though males may also have black setae.

Systematics. Ormyrids have sometimes been classified as their own family (Bouček 1988) or as a subfamily in either Pteromalidae (Burks 1979) or Torymidae (Bouček et al. 1981). Relationships of Ormyridae are still uncertain (Hanson 1992).

Biology. Ormyridae are parasites of insects in plant galls or, less commonly, in seeds. Most Nearctic species are associated with galls of Cynipidae; the majority of these species are restricted to cynipid galls on oaks (*Quercus*), as summarized by Hanson (1992). However, one Nearctic species, *Ormyrus rosae* Ashmead, is associated with cynipid galls on Rosaceae and one species, *O. vacciniicola* Ashmead, is associated with galls formed by *Hemadas nubilipennis* (Ashmead) (Pteromalidae) on blueberry (*Vaccinium*). Two species of Nearctic *Ormyrus* have also been reared from cynipid galls on Asteraceae, but their identity is uncertain (Hanson 1992). Host associations of Palearctic species of *Ormyrus* differ in several ways, including being associated with galls of Diptera (Hanson 1992).

Fauna/Literature. The family currently contains two recognized genera — the cosmopolitan *Ormyrus*, and the monotypic *Ormyrulus* Bouček from India. Hanson (1992) revised the Nearctic species of *Ormyrus* and recognized 16 species from the region.

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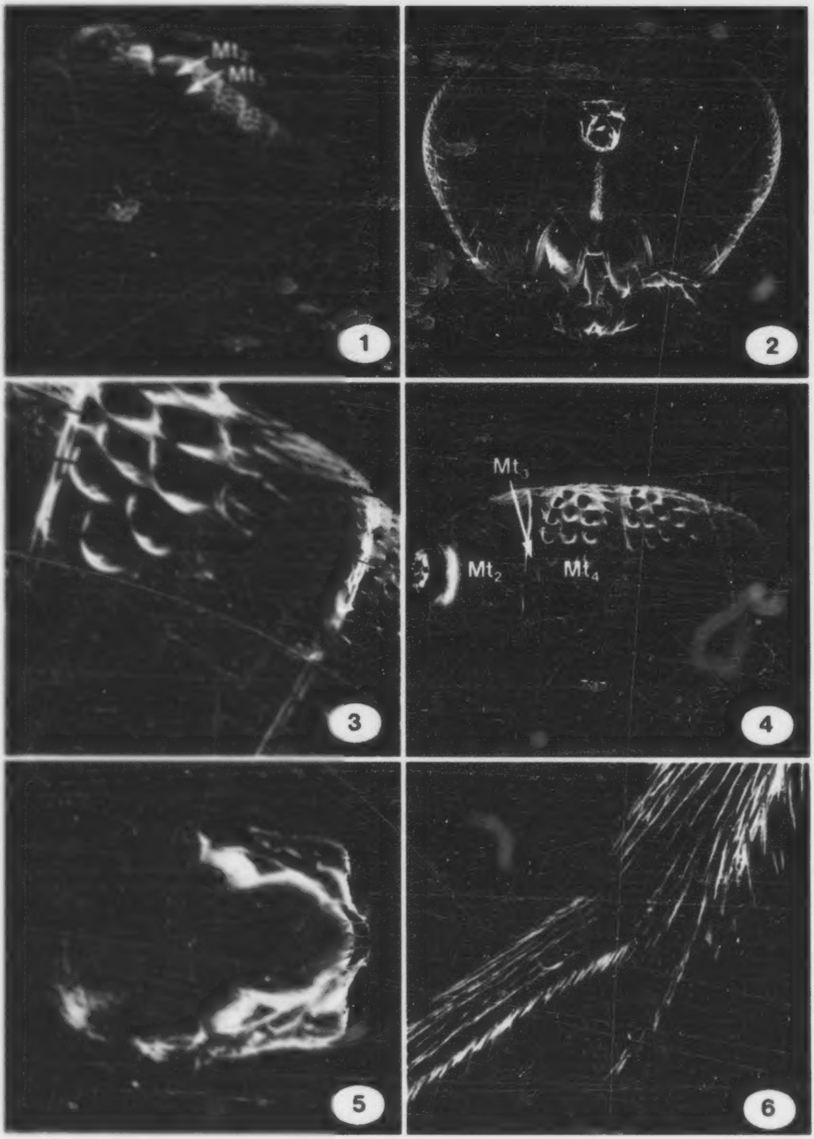
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Figs. 1–6. *Ormyrus vacciniicola* Ashmead: 1, ♀ body; 2, head (posterior); 3, ♀ Mt_5; 4, ♂ metasoma; 5, mesosoma; 6, metatibial spurs.

Chapter 16. **PERILAMPIDAE**

D. Christopher Darling

Recognition. Perilampidae in the Nearctic region are recognized by the following combination of features: antenna 13-segmented, including 1 anellus, 7 funicular segments, and 3 claval segments; clypeus differentiated from face by sutures, the anterior margin entire, without teeth or tubercles; mandibles robust, with 2 or 3 large teeth; mesosoma compact, usually short and high in lateral view (Figs. 1, 7), with pronotum visible in dorsal view (cf. Eucharitidae); notauli complete; and gaster usually high and triangular in profile (Figs. 1, 7), with Mt_2 and Mt_3 similar in size and fused dorsally, and Mt_2 having large lateral panel. In addition, the antennae are sexually dimorphic. The scape in males is modified, either expanded and/or with punctures or pores on the anterior surface.

Systematics. Considerable confusion exists over the limits of the family Perilampidae and the relationships of the included taxa with Eucharitidae. Most of this uncertainty revolves around the Chrysolampinae, which have been classified in either Perilampidae or Pteromalidae. A consensus is now emerging that the Chrysolampinae are best classified as a subfamily of Perilampidae, based on characters of the adults (Bouček 1988, Bouček and Rasplus 1991) and information on life history and immature stages (Darling and Miller 1991). Perilampinae and Chrysolampinae are morphologically and behaviorally distinct, and the two subfamilies are more easily recognized by the features given in the key than by the shared features given in the preceding diagnosis.

Perilampidae are closely related to Eucharitidae, with which they share a digitate labrum (Darling 1988*b*) and planidial first-instar larva (Heraty and Darling 1984, Darling and Miller 1991, Darling 1992). Nearctic Chrysolampinae, however, have a flap-like labrum (Darling 1986).

Biology. Perilampidae are parasites of other insects; their biology and life history are similar in many respects to Eucharitidae (Heraty and Darling 1984). Eggs are laid away from the host, on leaves, or flowers, or in preformed cavities in plant tissue. In western North America, species of *Chrysolampus* deposit eggs in the seed pods of legumes (Darling and Miller 1991). The first-instar perilampid larva is a sclerotized, active planidium, and development is hypermetamorphic; the subsequent larval instars are hymenopteriform. The planidia locate and parasitize the host; the existence of phoretic transport (cf. Eucharitidae) has not been documented but may occur in species that parasitize aculeate Hymenoptera. While on the host the planidia search out and kill conspecific competitors; only a single adult develops on a host individual.

The host associations of Perilampidae are extremely diverse, in sharp contrast to the Eucharitidae, which all parasitize ants. At least eight orders of insects serve as hosts and both primary and secondary parasitism occurs. Chrysolampinae are primary parasites of Coleoptera that feed in enclosed situations on flowering plants. In the Perilampinae, details of the life history and immature stages are known only for the genus *Perilampus*, although hosts are known for several genera. In the Old World tropics, species of *Monacon* Waterston are primary parasites of ambrosia beetles (Platypodidae) (Bouček 1980) and species of *Krombeinius* Bouček are primary parasites of aculeate Hymenoptera (Darling 1988*a*).

Fauna/Literature. Six genera and about 40 species are recognized in the Nearctic region. Darling (1983) reviewed *Euperilampus* and Darling (1986) revised Chrysolampinae. The vast majority of the species in the Nearctic region, as elsewhere, are classified in the genus *Perilampus*, which was revised by Smulyan (1936). Argaman (1990, 1991) proposed 26 new genera, but these were all synonymized with *Perilampus* by Darling (1996). Adults are usually collected on or near flowers or hovering near vegetation.

Key to genera of Perilampidae

1 Prepectus not closely associated with and not on same plane as lateral panel of pronotum (Fig. 2) (as in Pteromalidae); marginal vein 3.5–6 times as long as stigmal vein (Fig. 2); mandibles symmetric, each with 2 teeth .... CHRYSOLAMPINAE, 2

– Prepectus closely associated on same plane as and usually fused to lateral panel of pronotum (Figs. 1, 6, 7); marginal vein not more than 3 times as long as stigmal vein (Figs. 1, 6, 7); mandibles asymmetric, right mandible with 3 teeth, left mandible with 2 teeth .... PERILAMPINAE, 3

2(1) Metasoma sessile, without distinct petiole (Mt_1 transverse) and with remaining terga subequal in length .... ***Chrysomalla*** Förster
Key: Darling (1986). **Fauna**: 1 sp., *C. hesperis* Darling, widespread in southwestern USA (AZ, CA, ID, TX). **Hosts**: unknown, but probably Tychiinae (Curculionidae) based on the Old World species *C. roseri* Förster.

– Metasoma distinctly petiolate (Mt_1 distinctly longer than broad) (Fig. 2) and with Mt_2 and Mt_3 much larger than remaining terga (Fig. 2) .... ***Chrysolampus*** Spinola

Key: Darling (1986). **Fauna**: 5 spp., widespread in western North America from Canada (AB, Peace River region) to Mexico (Veracruz). **Hosts**: primary parasites of Tychiinae (Curculionidae) in seed pods of legumes (Fabaceae) (see Darling and Miller 1991).

3(1) Prepectus narrow, less than half as broad as adjacent pronotal panel (Fig. 7); marginal vein shorter than postmarginal vein (Fig. 7) ... . ***Euperilampus*** Walker

Key: Darling (1983). **Fauna**: 2 spp., *E. krombeini* Bouček in southwestern USA (AZ, NM) and Mexico, and *E. triangularis* (Say), widespread in eastern North America. **Hosts**: probably secondary parasites of Lepidoptera through Ichneumonidae.

– Prepectus broad and triangular, about as broad as adjacent pronotal panel (Figs. 1, 6); marginal vein as long as or longer than postmarginal vein (Figs. 1, 6) 4

4(3) Pronotum with raised processes (Fig. 6: pr), thoracic dorsum in lateral view irregular; ovipositor sheaths upturned, exserted and conspicuous (Fig. 6) .... ***Steffanolampus*** Peck

Fauna: 1 sp., *S. salicetum* (Steffan), in eastern and western North America. **Hosts**: associated with maples (*Acer*), probably a parasite of wood-boring Anobiidae or their predators (Rhipiphoridae) (see Bouček 1978).

– Pronotum without raised processes (Figs. 1, 7); thoracic dorsum in lateral view evenly convex; ovipositor sheaths concealed by metasomal terga (Fig. 1) 5

5(4) Metasoma distinctly petiolate, with Mt_1 at least twice as long as broad and uniformly alveolate or coriacious (Fig. 9); head without malar sulcus (Fig. 4) .... ***Burksilampus*** Bouček

Fauna: 1 sp., *B. anobii* (Burks), in USA (AZ, KS, NY, VA). **Hosts**: probably primary parasite of wood-boring Anobiidae (see Burks 1969 and Bouček 1978).

– Metasoma sessile (Fig. 1), or with short, transverse petiole, or if longer than broad then petiole with distinct rugae on dorsal surface (Fig. 8); head with malar sulcus (Fig. 3) or malar region with oblique costae (Fig. 5) .... ***Perilampus*** Latreille

Key: Smulyan (1936). **Fauna**: about 30 described spp., widely distributed. **Hosts**: extremely diverse, but usually conservative within species groups: primary parasites of wood-boring Anobiidae, stem-nesting Sphecidae, Chrysopidae, Diprionidae, and Tenthredinidae; secondary parasites of Lepidoptera, Rhaphidioidea (Neuroptera), Coleoptera, and Orthoptera through Ichneumonidae, Braconidae, and Tachinidae; and 1 sp. in Peru on Sclerogibbidae in the silk webs of Embioptera (Burks 1969). Notable is the *P. hyalinus* complex in which morphologically indistinguishable specimens are reared either as primary parasites of sawflies (Symphyta) or as obligate secondary parasites of Lepidoptera (Tripp 1962).

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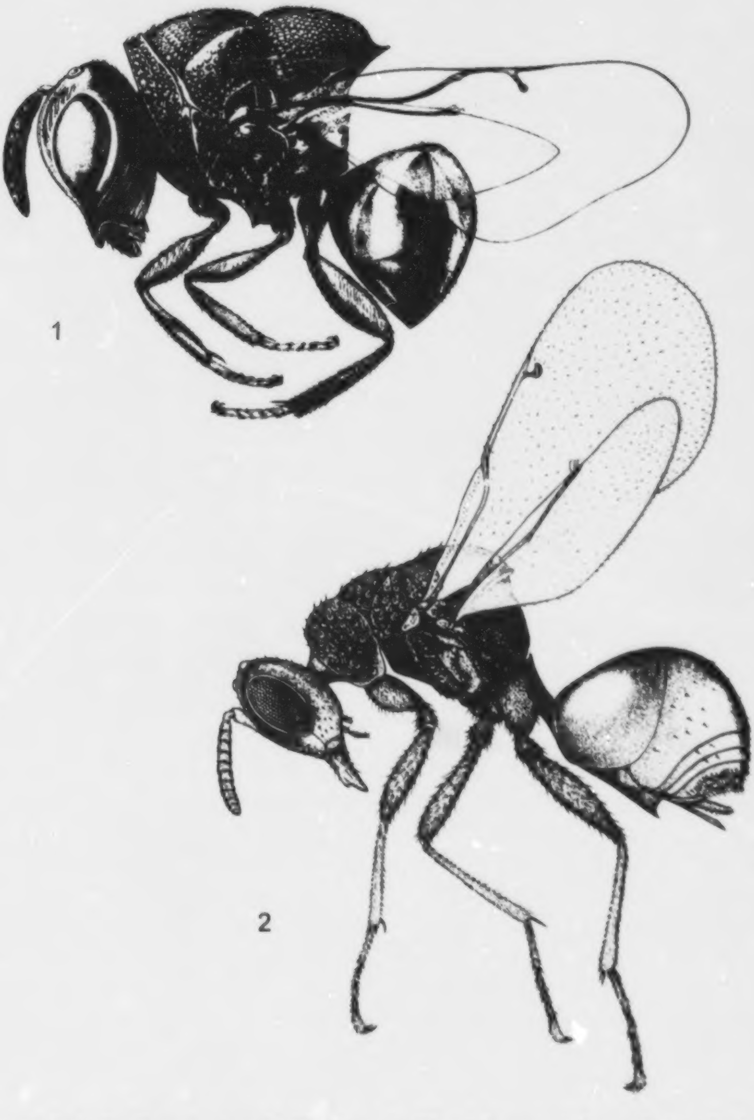
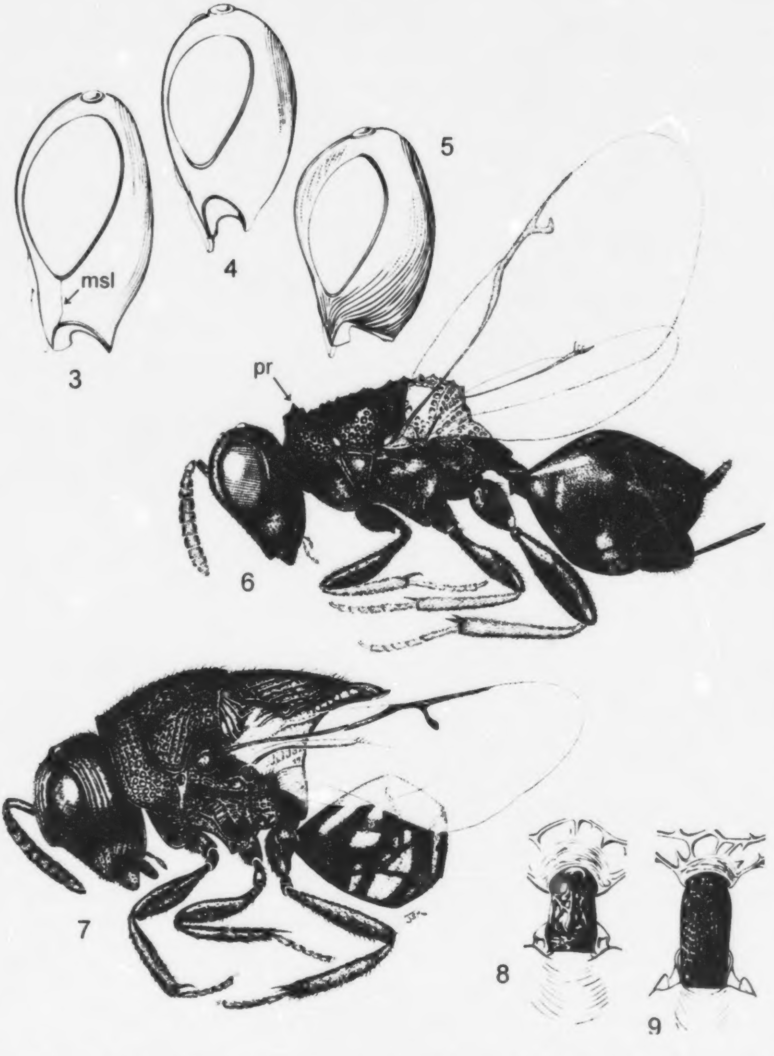


Figs. 1–2. 1, ***Perilampus regalis*** Smulyan. 2, ***Chrysolampus schwarzi*** Crawford.



Figs. 3–9. 3–5, head: 3, ***Perilampus stygicus*** Provancher; 4, ***Burksilampus anobii*** (Burks); 5, ***P. hyalinus*** Say. 6, ***Steffanolampus salicetum*** (Steffan) [abbreviation: pr = pronotal process]. 7, ***Euperilampus triangularis*** (Say). 8–9, petiole (dorsal): 8, ***P. stygicus***; 9, ***B. anobii***.

Chapter 17. **PTEROMALIDAE**

Zdenek Bouček and Steven L. Heydon

Recognition. The Pteromalidae are probably the most difficult chalcidoid family to define cladistically or phenetically. No single feature or suite of features will separate all species of Pteromalidae from all other families. In order to help the user overcome this problem our key includes outlets for the non-pteromalid taxa that might be mistaken for Pteromalidae, such as the Tetracampidae (*Epiclerus*), Agaonidae (*Aepocerus* and *Heterandrium*), Perilampidae (Chrysolampinae), and males of Torymidae and Eupelmidae. However, the Pteromalidae is not just a random conglomeration of groups as it appears under cursory examination. Detailed study of Pteromalidae shows that the various subfamilies all appear to be derived from either Cleonyminae or Ormocerinae. The Pteromalidae have retained many primitive character states and thus are currently defined negatively relative to related chalcidoid groups, i.e., they do not have the features that characterize the other families. Most Pteromalidae retain the primitive 13 antennal segments and five tarsal segments, which separate them from the Tetracampidae, Eulophidae, and related groups, which generally have fewer antennal and tarsal segments. Some Tetracampidae have 5-segmented tarsi so they are also included in the key. Darling and Miller (1991) and Heraty and Darling (1984) discussed synapomorphies that unite the Chrysolampinae with the Perilampidae plus Eucharitidae, but five of these characters are found only in the first instar larva. One of two adult characters that they discussed is the structure of the labrum of adults, which is mostly difficult to see without special preparation. The other adult character is the sexual dimorphism of the antenna, which cannot be evaluated in a single specimen. Consequently, the Chrysolampinae are also included in this key. Females of Torymidae have Mt_8 (= Gt_7) medially shortened and Mt_9 free on all sides except for its basal articulation with Mt_8. This exact structure is not found in females of any pteromalid genus (see chapter 21), but because males lack the feature they are difficult to separate from pteromalid males. Similarly, Pteromalidae lack the inflated mesopleuron characteristic of the Encyrtidae and Eupelmidae; but this character is not expressed in males of Eupelminae and so they are also included here.

Recently, Bouček (1988) found an additional character that may have value in defining the Pteromalidae. The occipital foramen in many Agaonidae and Torymidae is closed ventrally and separated from the mouth opening by a sclerotized extension of the occiput, the postgenal bridge (see Grissell 1995). In Pteromalidae, the postgenal bridge is absent and the region between the occipital foramen and mouth opening is membranous except for a few sclerites upon which the mouth parts are articulated. This character was discovered late in Bouček's study of the Australian fauna and so its value in determining relationships among Chalcidoidea could not be thoroughly evaluated at that time. This character is mentioned here in the hope that other such unevaluated characters may be found and phylogenetics of the Chalcidoidea improved.

Systematics. The concept of Pteromalidae has a long and complicated history (see the short review in Bouček 1988). From its creation as the Pteromalini by Dalman (1820) to the 1950's, the tendency was increasingly to separate several of the subfamilies, such as Spalangiinae, Miscogastrinae, and Cleonyminae, as separate families. Nikol'skaya (1952) divided the present Pteromalidae into five families. However, the tendency of recent authors and cataloguers (Graham 1969, Peck 1963, De Santis 1967, Burks 1979) has been to combine these taxa back into Pteromalidae. Burks (1979) goes so far as to include in the Pteromalidae the families that are treated here as Ormyridae and Perilampidae.

The subfamilial classification followed in this chapter is more or less that proposed in Bouček (1988). Most Nearctic genera fit into the accepted subfamilies but a few, such as *Morodora*, *Erixestus* and *Perniphora*, need further study to clarify their placement. Study of the higher classification of the Pteromalidae is still far from complete and there remains some uncertainty, even between us, on the placement of some of the tribes.

Biology. In keeping with their morphological diversity, Pteromalidae have a great diversity of hosts, including many different orders of insects and even spider egg sacs. If any generalization can be made, it is that pteromalids parasitize mainly larvae and/or pupae of small insects feeding in or on plants. Rearing insects from materials such as oak galls, dead wood and twigs, stems of herbaceous plants (especially of grasses), flower heads of Asteraceae, shelf fungi, or even dung, will yield species of Pteromalidae. However, their exact trophic relations are often difficult to determine because usually a variety of potential hosts emerge as well.

Although there remain many gaps in our knowledge of the hosts of particular genera or species, at least some guess can be made about the hosts of many Pteromalidae because the various groups often parasitize hosts in similar situations or they parasitize related taxa. Several of the apparently more primitive subfamilies, such as the Cleonyminae, Macromesinae, Colotrechninae, and Cerocephalinae, are mostly parasites of insects associated with decaying wood. Their hosts are primarily Scolytidae, Anobiidae or Curculionidae, though *Epistenia* (Cleonyminae) deviates in parasitizing Aculeata nesting in holes of wood or twigs. *Colotrechnus ignotus* Burks (Colotrechninae) has been reared from larvae of Diptera in flower heads. The hosts of Spalangiinae, as far as is known, are all Diptera in decaying plant or animal tissues or in dung; known host families include the Muscidae, Calliphoridae, Sarcophagidae, Drosophilidae, and Chloropidae. Much research on the biology of species of *Spalangia* and their value in biological control of synanthropic flies has been conducted because many hosts are flies associated with the dung of domesticated animals (see review by Rueda and Axtell 1985). Species of Eunotinae attack Pseudococcidae and because of their value in biological control many species have been moved throughout the world; more than half of the Nearctic genera have species introduced from other regions. *Erotolepsia* (Erotolepsiinae) has been reared from pupae of Stratiomyidae. The Asaphinae could be considered pests because species of *Asaphes* are hyperparasites of Aphididae through Aphidiinae; *Hyperimerus* has been reared from Neuroptera feeding on aphids. Some other subfamilies (including at least some species of Diparinae) are associated with hosts living in leaf litter. The majority of Herbertiinae, Pireninae, Ormocerinae, Miscogastrini and Sphegigastrini (sensu Bouček 1988) are parasites of Diptera living in plants. Species of some genera, such as *Systasis* (Systasini), develop in Diptera galls and *Gastrancistrus* (Pireninae) are parasites of Cecidomyiidae. The Miscogastrini are parasites of Diptera (e.g., Agromyzidae and Anthomyiidae) mining leaves or soft parts of plants. The hosts of Sphegigastrini are often Diptera living in more rigid substrates such as plant stems. However, *Ormocerus* (Ormocerini) are associated with Cynipidae on *Quercus*

Species of Pteromalinae, the largest subfamily, have diverse life histories. Many are parasites of holometabolous insects associated with the aerial parts of plants. There are relatively few soil-frequenting species, but *Diglochis* have been reared from pupae of Tabanidae in damp ground. The species of *Urolepis*, *Muscidifurax*, and *Pachycrepoideus* are important parasites of flies in animal dung or decaying plant material. *Anisopteromalus*, *Dinarmus*, *Lariophagus*, and *Hemitrichus* parasitize Coleoptera, mainly Bruchidae, in stored grain or in the field. Species of some genera parasitize hosts in semiaquatic habitats: *Dineuticida* and *Gyrinophagus* are parasites in cocoons of Gyrinidae, and *Sisyridivora* have been reared from cocoons of Sisyridae. Many pteromalids are restricted to hosts in specific microhabitats, but some widely polyphagous species are known. Species in quite a number of genera, including *Dibrachys*, *Trichomalopsis*, *Psychophagus*, *Catolaccus*, *Toxeumella*, *Euneura*, *Hypopteromalus*, *Pachyneuron*, and some *Pteromalus*, are hyperparasites of other parasitic Hymenoptera. Species of *Ficicola* and *Nadelaia* are associated with figs (*Ficus*). *Arachnopteromalus*, *Epipteromalus algonquinensis* Ashmead, and *Pteromalus platyphilus* Walker are predators of eggs in egg sacs of spiders

(Araneae). *Systellogaster ovivora* Gahan is known from oothecae of cockroaches (Blattaria). Species of *Caenocrepis* are known from the eggs of Curculionidae and species of *Tomicobia* are parasites of adult Scolytidae or Curculionidae.

A few phytophagous pteromalids are known. *Hemadas nubilipennis* (Ashmead) makes galls on blueberry (*Vaccinium*). The biology of *Systasis* (Ormocerinae) is still incompletely known, but some species appear to be phytophagous in grass seeds (Poaceae) for at least part of their life cycle (Heydon 1995*b*).

The hosts of other subfamilies are little known. The Leptofoeninae are collected in association with dead wood and have a body structure similar to parasites of other wood-boring insects. Study is needed on the biology of the Ceinae. A European species was recorded from Agromyzidae mining leaves of Apiaceae (Bouček 1961). However, the Nearctic *Spalangiopelta apotherisma* Darling & Hanson came out of an egg mass of *Lymantria dispar* L. (Lymantriidae) (J. Huber, personal communication), and Darling and Hanson (1986) reported that *Spalangiopelta* had been collected in Douglas fir duff in Berlese funnels. There is clearly more to learn about the biology of Ceinae than we know at present. The hosts of Diparinae are mostly unknown except for a record of one species from India on Curculionidae on the base of the stem of *Cyperus* (Bouček 1988). Because of this record and because they are sometimes wingless and can be taken in Berlese funnels, it is presumed their hosts are soil-inhabiting Coleoptera.

Fauna. The Pteromalidae is one of the largest families of Chalcidoidea with over 3,000 species described in 552 genera worldwide (J. S. Noyes, personal communication). Our knowledge of the Nearctic pteromalid fauna is still incomplete, but as recently as Burks (1979) and De Santis (1979) 126 genera were treated in the subfamilies included in Pteromalidae as defined herein. Despite the loss of 11 of these genera through synonymy, our key treats 230 genera, and still other genera remain to be discovered. There are about 400 described Nearctic pteromalid species, but the true number occurring in the Nearctic region is probably somewhere around 1,500.

Literature. No modern reviews of the Nearctic genera of the Pteromalidae exist. Nearctic workers relied on a series of reviews of the Palaearctic fauna (Bouček and Hoffer in Peck et al. 1964, Graham 1969, Bouček and Rasplus 1991), supplemented by their knowledge of the Nearctic taxa that do not occur in these works. In some ways, reliance on these Palaearctic keys was fortunate because the faunas are so similar, and many unrecorded genera could be recognized from the keys. Thus, little generic synonymy was created. Generic reviews published since those in Burks (1979) and De Santis (1979) are listed following the generic name in the couplet where most species of the genus key out. In genera for which species are listed and no recent generic review has been published the user can be consoled by the fact that we have found that the species names listed in the catalogs often have little meaning. In most cases this is because the type series contains a mixture of species or there are so many undescribed species that the chances of having one of the described ones, especially in western USA, Canada, and Mexico, are actually quite small. The still poor knowledge of the Nearctic Pteromalidae is often reflected in the fact that some species cannot be identified to genus with certainty. Presently we are trying to define the extent of the intrageneric variation. In some cases the progress will inevitably lead to synonymy of some generic names and to recognition of new ones.

Use of key. The following key to the genera of Pteromalidae is long and somewhat difficult. The sources of difficulties for the user (as well as the authors) are many. Our knowledge of the Nearctic species is still very incomplete. In the 10 genera already recorded from the USA and Canada that the junior author has treated over the last decade, the number of new species outnumbers the previously described species by about 2 to 1. Distinction between genera of certain difficult groups, such as those close to *Lamprotatus*, will be improved only when the Nearctic species in these genera are revised. Our present classification is based to a large extent on the pteromalid fauna of Europe and we have found that, in many cases, the same genera are less homogenous in appearance in the Nearctic region. In some cases, genera, such as *Lyrcus* or *Chlorocytus*, have a certain gestalt that, once learned, enables their ready recognition, but the variation among species is such that a single suite of characters is insufficient for generic classification of all species. Practice will rapidly improve the ability of the user to recognize such taxa. Further complications are added by the fact that despite the publication by the authors of 39 new genera in the past five years, more new Nearctic genera await discovery. However, the user should take heart in knowing that the key is fairly forgiving and in many cases, such as when it is difficult to tell if the notauli are complete or not, borderline cases can be run through in both alternatives of the couplet.

In a number of genera males are unknown or are not sufficiently known to be included in the key. Some couplets, therefore, are based only on females. One should try to continue to key males through either part of an all-female couplet because in later couplets male features usually are given and the specimen may be identified. One important character used in the key is the number of anelli. Some or all males of certain genera in which females have three anelli have only two anelli, and such males sometimes key out in other couplets. The length of the petiole is often greater in the male than in the female, which may place the sexes of the same species in different parts of the key. This may pose difficulties especially where the other sex is not yet known.

Certain words used in the following key are used in a specific sense. For example, oblong is slightly longer than broad whereas elongate is much longer than broad. Often, illustrations will make this clear. Thoracic dorsum refers to the dorsal surface of the prothorax and mesothorax. Pronotum 'margined' refers to a clear separation of the sloping part (neck) from the dorsal part (collar) of the pronotum, either by a rounded or blunt edge, an obtuse-angular or rectangular edge, or a carinate edge. The apex of the stigmal vein, the stigma, is usually more or less enlarged; if conspicuously button-like the stigma is termed 'capitate'. The position of the torulus in relation to the eye or face always means the lower margin of the torulus. Important structures described in the key are indicated by arrows on the scanning electron micrographs that illustrate the features.

Attention to a few details of technique will also aid the user of the key. Light is of primary importance in successfully observing many characters, especially of sculpture. Strong light, e.g., from incandescent or fiber optics systems, is reflected strongly by cuticle, and produces interference that limits resolution. Clarity can be greatly improved by diffusion of the light through translucent (matt) film placed just in front of the specimen (Goulet and Mason 1993). Using a fluorescent light source will also eliminate light interference by cuticle. It is important to have a microscope that can magnify at least 50x with very good resolution. The magnification should come, as much as possible, from the objective lens rather than the eyepiece. It is also important that the specimens be clean and well mounted. A series of specimens, mounted in identical fashion, is also helpful for determining which differences are specific and which are the results of individual variation.

Key to genera of Pteromalidae

1 Toruli at extreme lower margin of head (Fig. 378) and lateral to clypeus on lobes overhanging mouth; head almost prognathous, with occipital foramen near vertex; flagellum without anellus, with 7 funicular segments, and with clava undivided (Fig. 2); body black; gaster on petiole .... SPALANGIINAE, 2

– Toruli always at least slightly, but often far, from lower margin of head; other characters at least in part different 3

2(1) Occipital carina present and well developed; upper face with median line of punctures in front of ocellus (Fig. 378); propodeum with 2 convergent submedian lines of punctures (Fig. 1); head and thorax usually with deep setiferous punctures, the surface between them shiny; petiole elongate and with longitudinal ribs; gaster with Gt$_3$ usually larger than Gt$_2$; body usually over 2 mm long; always fully winged .... ***Spalangia*** Latreille

Fauna: at least 12 spp. **Hosts**: puparia of Diptera; 6 spp. are on synanthropic flies. (See Burks 1969*b*.)

– Occipital carina absent; upper face and propodeum without lines of punctures; head and thorax with microscopic reticulation, hence dull, and with erect soft setae but without any conspicuous punctures; petiole subquadrate (Fig. 3), without ribs; Gt$_3$ shorter than Gt$_2$; body less than 1.5 mm long; sometimes short-winged (Fig. 3) .... ***Playaspalangia*** Yoshimoto

Fauna: 1 sp., *P. rothi* Yoshimoto (1976), in Mexico (coast of Sonora) [also Sri Lanka]. **Hosts**: Diptera under rotting algae.

3(1) Head subcubical, with raised rough parascrobal crests separated by deep scrobes (Fig. 379); pronotum neck-like, in dorsal view much longer than broad; body always over 8 mm long and very slender (Fig. 4), with compressed gaster on long petiole. *Female*: with long ovipositor sheaths .... LEPTOFOENINAE, ***Leptofoenus*** Smith

Key: LaSalle and Stage (1985). **Fauna**: 1 sp., *L. rufus* LaSalle & Stage, in southwestern USA [genus mainly Neotropical]. **Hosts**: probably Coleoptera in dead wood.

– Head and pronotum quite different; body much shorter or with different gaster 4

4(3) Head between toruli with conspicuous, protruding vertical ridge or tooth (Figs. 6, 8, 380) and with occipital carina strong; body shiny, most of its surface smooth, yellowish to black or, rarely, yellow with metallic sheen; wings, if not reduced, without conspicuous setae on disc but with long marginal setae (Fig. 5), the marginal vein fairly long but postmarginal and stigmal veins short. [Notauli complete; ovipositor sheaths often protruding (Fig. 10).] .... CEROCEPHALINAE, 5

– Head between toruli without projection [except in *Ficicola* (couplet 105) and *Habritys* (couplet 180)] but with occipital carina absent (in most species), weak, or strong; at least thorax with some areas sculptured or densely setose; if head and sculpture somewhat similar to above then without occipital carina and wings different 10

5(4) Head more or less parallel-sided or broadening anteriorly, subprognathous (Figs. 7, 8), with mandibular bases wide apart; short-winged forms common 6

– Head with rounded sides, subglobose (Figs. 6, 380) to elongate; mandibular bases not unusually wide apart; fully winged 8

6(5) Mandibles very long (Fig. 8); head subquadrate and slightly broadening anteriorly; body dark and submetallic; fully winged, the forewing without tuft of setae on parastigma. *Female*: flagellum 7-segmented. *Male*: flagellum 8-segmented .... ***Acerocephala*** Gahan

Fauna: 2 spp. **Hosts**: Scolytidae and Curculionidae in cones of *Pinus*. (See Gahan 1946.)

– Mandibles shorter; head at least slightly longer than broad, with subparallel sides (Figs. 7, 9); body yellowish but often with metallic sheen; wingless (ant-like) to fully winged. *Female*: flagellum often 5-segmented, rarely 6-segmented 7

7(6) Flagellum strongly clavate and short (Fig. 7), with funicle only about as long as scape and with most funicular segments strongly transverse; winged specimen without parastigmal tuft of setae; body without metallic sheen .... ***Choetospilisca*** Hedqvist

Fauna: 1 sp., *C. tabida* (Gahan). **Hosts**: Cossoninae (Curculionidae) in dead tree branch, based on one rearing in USA (MD).

– Flagellum at most slightly clavate, with funicle much longer than scape (Fig. 9) and with funicular segments subglobose or subquadrate, the segments not unusually short; winged specimen with distinct tuft of black setae on parastigma (as in Fig. 5) and body often with some metallic sheen .... ***Theocolax*** Westwood

Fauna: 1 sp., *T. elegans* (Westwood). **Hosts**: small Coleoptera, in particular *Stegobium paniceum* (L.) (Anobiidae) in stored grain.

8(5) Forewing with distinct tuft of stiff setae on parastigma (Fig. 5) .... ***Cerocephala*** Westwood

Key: Grissell (1981). **Fauna**: 2 spp. **Hosts**: Anobiidae and Scolytidae.

– Forewing without tuft of setae on parastigma 9

9(8) Head between toruli with strong tooth-like projection and lateral to torulus with high ridge forming a high lobe near mouth; propodeum entirely densely sculptured. *Female*: antenna stout and clavate, with scape curved and tapering to base, and with most funicular segments slightly transverse, bead-like, and distinctly setose .... ***Neocalosoter*** Girault & Dodd

Note: probably better classified as a subgenus of *Cerocephala*.

Fauna: 2 spp. **Hosts**: Scolytidae (Bouček 1988).

– Head between toruli with gentle though carinate ridge and lateral to torulus with very weak ridge (Fig. 11); propodeum extensively smooth except for irregular areolation along middle, the areolate area expanding in posterior half. *Female*: antenna (including scape) slender, with all funicular segments slightly oblong (not bead-like), and with setae sparse and very short .... ***Laesthiola*** Bouček

Fauna: 1 sp., *L. flavida* Bouček (1993*b*), in USA (southern FL).

10(4) Axillae strongly advanced (Figs. 12, 18, 381, 382, 384), with most of surface anterior to anteromedian margin of scutellum; notauli posteriorly curving outwards and, if complete, ending far in front of anterior margin of scutellum 11

– Axillae not advanced or only moderately so (Figs. 387, 388, 392), most of surface posterior to anteromedian margin of scutellum; notauli, if complete, ending close to anterior margin of scutellum 17

11(10) Scutellum dorsally with conspicuous axillular grooves (Figs. 16, 381, 382), i.e., axillulae enlarged and axillular grooves moved to dorsal surface, the grooves posteriorly often curved outwards; pronotum very short, dorsally rounded, hence collar not distinct .... COLOTRECHNINAE, 12

– Scutellum without axillular grooves, the axillulae small and, in dorsal view, hidden below lateral margin of scutellum (Figs. 388, 392, 408); pronotum often different 15

12(11) Forewing with parastigma and stigma both conspicuously enlarged and darkened (Figs. 15, 16): flagellum with 2 or 3 anelli and 4 funicular segments; clava with apex acuminate (Figs. 17*a*, 17*b*); head in anterior view obviously transverse, with eye rounded-subtriangular. *Male*: marginal vein entirely thickened .... ***Dipachystigma*** Crawford (part)

Fauna: 2 spp. **Hosts**: 1 sp. reared from *Stephanoderes* (Scolytidae).

– Forewing with at least parastigma not enlarged and not darker than marginal vein (Figs. 13, 14); flagellum with 2 anelli and either 5 or 6 funicular segments; clava not acuminate; head usually different. *Male*: marginal vein not thickened 13

13(12) Mesoscutum with notauli conspicuous, broadly groove-like except mesal to axillae; face dull, with dense reticulation but without distinct setiferous punctures; forewing with stigma subquadrate (Fig. 13); eyes short, in lateral view rounded-subtriangular and in anterior view with inner margins strongly diverging in lower half. *Female*: flagellum with 2 anelli and 5 funicular segments .... ***Elachertodomyia*** Girault

Fauna/Hosts: probably 2 spp., mainly *E. phloeothribi* (Ashmead) on Scolytidae and Curculionidae in twigs.

– Mesoscutum with notauli shallow, at most more or less groove-like in anterior half (Figs. 381, 382); face fairly shiny, with reticulation faint but with distinct setiferous punctures; forewing with stigma often different; eyes in lateral view usually distinctly elongate and in anterior view with inner margins straight and only slightly diverging. *Female*: flagellum usually with 2 anelli and either 5 or 6 funicular segments (rarely with 3 anelli and 5 funicular segments) 14

14(13) Torulus distinctly above lower margin of eye; clypeus rather short and not produced, with truncate apical margin; mouth narrow; mesosoma rather high; mesoscutum rather narrow, with median length twice distance between axillae; scutellum between axillular grooves slightly longer than broad; stigma knobbed and almost sessile (Fig. 14) .... ***Colotrechnus*** Thomson

Fauna: 1 described, common sp., *C. ignotus* Burks, and at least 2 undescribed spp. **Hosts**: Agromyzidae in flower heads (new record).

– Toruli below lower margin of eye; clypeus produced, with apical margin in broad arch; mouth unusually broad, more than 3 times as broad as malar space (Fig. 383); mesosoma depressed; mesoscutum broad and flat, much shorter than twice distance between axillae; scutellum between axillular grooves broader than long; stigma hardly knobbed and petiolate (Fig. 12) .... ***Baridobius*** Heydon

Fauna: 1 sp., *B. primulus* Heydon (1994), in midwestern USA. **Hosts**: *Baris callida* Casey (Curculionidae).

15(11) Pronotum sloping forwards from posterior margin, without margin separating collar from neck (Fig. 401); postmarginal vein more than half length of marginal vein; stigmal vein with long uncus (Fig. 81); forewing broadly infumate; head with very fine, sometimes indistinct, occipital carina .... ***Hemadas***, see 68

– Pronotum with distinct, anteriorly margined collar (Fig. 18); postmarginal vein either absent or very short; stigmal vein with short uncus; forewing hyaline; head without occipital carina .... EUTRICHOSOMATINAE, 16

16(15) *Female* (male unknown): marginal vein about 4 times as long as straight stigmal vein; postmarginal vein short but distinct (Fig. 18); body with thin setae; Gt_1 and Gt_2 enlarged; flagellum with 2 anelli and 6 funicular segments. .... ***Peckianus*** Bouček

Fauna: 1 sp., *P. laevis* (Provancher), in Canada (ON). **Hosts**: *Apion* (Apionidae). (See Bouček 1974.)

– *Both sexes*: marginal vein hardly longer than elbowed stigmal vein (Fig. 20); postmarginal vein absent; body covered with flattened and broadly scale-like setae (Fig. 384); Gt_2 not enlarged; flagellum with 1 anellus and 7 funicular segments (Fig. 19) .... ***Eutrichosoma*** Ashmead

Fauna: 1 sp., *E. mirabile* Ashmead, from Mexico to southern Canada. **Hosts**: Curculionidae, probably on *Parthenium*. (See Bouček 1974.)

17(10) Antenna with fewer than 13 segments, indistinctly 10-segmented (in some *Macroglenes*) to 12-segmented; notauli complete 18

– Antenna with 13 segments (clava always counted as 3-segmented even if sutures indistinct or if appearing 4-segmented as in some *Coelopisthia* and *Diglochis*) **or, if** 12-segmented (*Amphidocius*), notauli incomplete; notauli variable. [Flagellum with basal 1, 2, or more segments almost always reduced to anelli.] 40

18(17) Gt_1 greatly enlarged and bell-shaped (Figs. 21, 23, 28) and gaster broadly sessile (except in *Tomocerodes* in which Gt_2 very broad but dorsally fused with Gt_1, Fig. 25); gena carinate posteriorly in most species. [Pronotum short, without distinct collar; notauli complete.] 19

– Gt_1 generally smaller or, if evidently enlarged, gaster not broadly sessile; gena posteriorly not carinate 26

19(18) *Both sexes*: flagellum with 1 anellus and 6 distinct funicular segments (Figs. 22, 24) or with 7 segments if clava 2-segmented; vertex not separated from occiput by sharp ridge 20

– *Female*: flagellum with only 5 distinct segments between pedicel and clava (Fig. 26). *Male*: flagellum with 4 distinct segments between pedicel and clava, the clava clearly 3-segmented (Fig. 27). *Both sexes*: vertex often separated from broadly concave occiput by sharp ridge touching eyes and posterior ocelli (Figs. 28, 29) .... EUNOTINAE, 21

20(19) Scrobes delimited by strong semielliptic carina (Fig. 22); Gt_1 with distinct longitudinal striae (Figs. 21, 385); body with subdecumbent bristles on pronotum and mesonotum, and scutellum with 2 longer bristles laterally on frenal line; stigmal vein longer than in Fig. 23 .... EROTOLEPSIINAE, ***Erotolepsia*** Howard

Fauna: 1 undescribed sp. in USA (TX). **Hosts**: reared from pecan [1 sp. from Neotropical region reared from Stratiomyidae].

– Scrobes not delimited by carina (Fig. 23); Gt_1 without distinct longitudinal striae (Fig. 23); body regularly densely setose, including head, large eyes, pronotum, mesonotum, and wings; stigmal vein very short (Fig. 23) .... HERBERTIINAE, ***Herbertia*** Howard

Key: Burks (1959). **Fauna/Hosts**: at least 1 sp., *H. wallacei* Burks, on *Phytomyza ilicicola* Loew (Agromyzidae); about 8 more spp., mainly in the tropics.

21(19) Scutellum with at least some short setae but without any strong bristles (Figs. 28, 386, 387) [and usually with apex produced over metanotum (Fig. 386)] 22

– Scutellum without setae except for 2 or 3 pairs of strong conspicuous bristles (Fig. 29) 25

22(21) Forewing with angular excision on anterior margin at apex of costal cell (Fig. 28), and disc bare in basal third; scutellum shiny and flat, posteriorly with shallow punctate groove delimiting distinct marginal rim .... ***Mesopeltita*** Ghesquière

Fauna: 1 introduced sp., *M. truncatipennis* (Waterston) (= *atrocyanea* Masi, see Bouček 1976), in southern USA. **Hosts**: *Saissetia* (Coccidae).

– Forewing without excision on anterior margin and disc extensively setose; scutellum different, often dull and without groove delimiting marginal rim 23

23(22) Thoracic dorsum smooth and shiny between setiferous punctures; gena smooth; scutellum evidently convex (Fig. 26); Gt_1 hardly covering half length of gaster .... ***Cephaleta*** Motschulsky

Fauna: 1 introduced sp., *C. brunniventris* Motschulsky, in USA (FL). **Hosts**: *Saissetia* (Coccidae).

– Thoracic dorsum and gena reticulate, dull; scutellum weakly convex or flat; Gt_1 covering at least half length of gaster 24

24(23) Scutellum produced as flat roof far over gaster (Fig. 386); hind wing broader than half width of forewing .... ***Scutellista*** Motschulsky

Fauna: 1 widespread sp., *S. caerulea* (Fonscolombe) (= *cyanea* Motschulsky, see Graham 1969). **Hosts**: predator of eggs of Coccidae and Pseudococcidae.

– Scutellum not extending over gaster, only about as long as mesoscutum (Fig. 387); hind wing narrower than half width of forewing .... ***Eunotus*** Walker

Fauna/Hosts: at least 3 spp., mainly *E. americanus* Girault on the grass *Eriopeltis festucae*; parasites of Pseudococcidae on grasses.

25(21) Gaster mostly covered by basal 2 terga, with Gt_2 about 3 times as long as Gt_1 (Fig. 25); gaster anteriorly with only a few setae on each side; propodeum with short nucha (Fig. 25) .... ***Tomocerodes*** Girault

Fauna: 1 sp., *T. americanus* Girault. **Hosts**: predator of *Lecanodiaspis prosopidis* (Maskell) (Lecanodiaspididae).

– Gaster with Gt_1 the largest, covering more than two-thirds length of gaster (Fig. 29); gaster anteriorly with thick tufts of whitish seta on each side; propodeum tapering into distinct nucha (Fig. 29) .. .. ***Moranila*** Cameron

Fauna: 1 sp., *M. californica* (Howard), in southern USA. **Hosts**: mainly primary parasite in various subtropical Pseudococcidae.

26(18) Gaster on distinct sculptured petiole; flagellum without anelli, but with 7 funicular segments, the first longer than the second (Figs. 30, 31); clypeal margin bidentate but asymmetric; head and thoracic dorsum with regular raised reticulations; body similar to *Halticoptera*. *Male*: palpi enlarged (Fig. 32) .... ***Andersena*** Bouček

Fauna: 1 sp., *A. anomala* Andersen, in USA (CA). (See Bouček 1993*b*.)

– Gaster sessile or subsessile, not on sculptured petiole; flagellum often with 1 or several anelli, or with fewer funicular segments (Figs. 40, 41, 43, 44); clypeal margin different, symmetric; head and thorax often with sculpture different; body not similar to *Halticoptera*. *Male*: palpi in most species not enlarged 27

27(26) Forewing with base of marginal vein and stigma greatly enlarged **and** scutellum in dorsal view with axillular grooves distinct; flagellum with 2 or 3 anelli and 4 or 5 funicular segments (Figs. 17*a*, 17*b*) .... ***Dipachystigma*** Crawford, see 12

– Different from above, rarely only either base of marginal vein enlarged **or** stigma button-like but then flagellum different **and** without distinct axillular grooves 28

28(27) Pronotum, at least medially, with transverse carina or edge (Figs. 38, 39) 29

– Pronotum dorsally rounded 30

29(28) Propodeum and metacoxa with conspicuous dense white setae laterally (Figs. 38, 388); head shiny and smooth, with sparse long whitish setae; torulus slightly above middle of face; prepectus almost fused with pronotum .... ***Erixestus*** Crawford (part)

Fauna: 1 sp., *E. winnemanae* Crawford. **Hosts**: parasite of eggs of *Calligrapha* (Chrysomelidae).

– Propodeum and metacoxa without conspicuous setae laterally (Fig. 39); head with at least upper face having some rugulose reticulation and setiferous punctures; torulus slightly below middle of face; prepectus clearly separated from pronotum .... ***Bugacia*** Erdös

Fauna: 1 undescribed sp. in USA (IA). **Hosts**: unknown, but extralimital spp. on Cecidomyiidae.

30(28) *Female only*: forewing densely setose, with marginal vein twice as long as costal cell, and with stigmal vein very short but with conspicuous uncus (Fig. 34); gaster often with cross-depression at posterior margin of Gt_1 .... see ***Epiclerus*** Haliday, **TETRACAMPIDAE**

– *Both sexes*: forewing basally with bare areas and venation different, in particular marginal vein much shorter; gaster different 31

31(30) Flagellum with second funicular segment anelliform (Fig. 33) 32

– Flagellum with second funicular segment not much smaller than first or third segment 33

32(31) *Male only*: metatibia with 2 conspicuous spurs; pronotal collar half as long as mesoscutum; pronotum, mesoscutum, antenna, and legs yellow .... see ***Heterandrium*** Mayr, **AGAONIDAE**

– *Both sexes*: metatibia with outer spur indistinct; pronotal collar shorter; thorax entirely dark and submetallic, antenna and legs partly fuscous .... (? aberrant) ***Gastrancistrus***, see 39

33(31) Face polished, smooth and shiny, without trace of sculpture, but with dispersed setae; clypeus well delimited, with apical margin bilobed; metacoxa with dense white setae (Figs. 38, 388) .... ***Erixestus*** Crawford, see 29

– Face, at least in some places, with distinct sculpture; clypeus delimited only by distinct tentorial pits, with apical margin straight (Fig. 389) or arched; metacoxa without very dense setae 34

34(33) Torulus about in middle of face; flagellum with 3-segmented clava and in most species with 2 distinct anelli and 5 funicular segments (Figs. 35, 37) or with several basal segments anelliform; lower face with conspicuous tentorial pits (Fig. 389); clypeus quadrate, with apical margin truncate .... ORMOCERINAE, 35

– Torulus below middle of face and flagellum different (flagellum of female **either** with only 1 discernible anellus and 5 funicular segments **or** with fewer than 7 discernible segments between pedicel and 3-segmented clava **or**, especially in male, clava only 2-segmented, its first segment indistinguishable from preceding funicular segments, hence funicle 7-segmented, Fig. 75); lower face without conspicuous tentorial pits; clypeus with sides strongly converging and apical margin produced (Figs. 40, 43) .... PIRENINAE, 36

35(34) Thoracic dorsum densely reticulate, without distinct setiferous punctures, and mostly rather dull; forewing bare behind marginal vein except for row of longer setae on underside (Fig. 36) .... ***Systasis*** Walker

Key: Heydon (1995*b*). **Fauna**: 5 spp. **Hosts**: in bud galls of Ericaceae, galls of Cecidomyiidae, and in seeds of grasses (Poaceae), probably phytophagous.

– Thoracic dorsum with very distinct setiferous punctures, these visible even if ground sculpture dense; forewing with most of area behind marginal vein as setose as in center of wing .... ***Semiotellus*** Westwood

Note: not yet recorded, but probably occurs in region because species known from all other temperate to tropical regions; 1 sp. in Costa Rica.

36(34) Marginal vein at least 3.5 times as long as stigmal vein; stigmal vein almost at right angle to wing margin (Fig. 41); flagellum with only 5 short segments between pedicel and clava and with at least 2 segments (sometimes all) anelliform. *Female*: hypopygium almost reaching apex of gaster (Fig. 390); ovipositor often protruding. *Male*: some species with eyes greatly enlarged (Fig. 40) .... ***Macroglenes*** Westwood

Fauna: several spp. **Hosts**: Cecidomyiidae on grasses.

– Marginal vein relatively much shorter (Figs. 48, 51); stigmal vein variable; flagellum in most species with at least 6 segments between pedicel and clava. *Female*: hypopygium usually not exceeding middle of gaster (Fig. 391). *Male*: eye not abnormally enlarged 37

37(36) *Female* (male unknown): head in anterior view about 1.5 times as long as broad, with eye fully 1.9 times as long as broad (Figs. 43, 44); flagellum with 1 distinct narrow anellus, with 1 transverse anelliform segment, and with 3 subtransverse funicular segments having longitudinal sensilla (Fig. 43); hypopygium short but almost reaching apex of gaster; venation similar to *Gastrancistrus* (Fig. 42) .... ***Lasallea*** Bouček

Fauna: 1 sp., *L. angusta* Bouček (1993*b*), in USA (NM).

– *Both sexes*: head more or less transverse, at most hardly longer than broad and with eye much shorter. *Female*: flagellum and hypopygium different 38

38(37) Pronotum in dorsal view, particularly in female, narrowing posteriorly, hence separated from mesoscutum by slight constriction (Fig. 47). *Male*: tibiae strongly inflated (Fig. 46) and dark-colored. *Female*: hypopygium almost reaching apex of gaster .... ***Spathopus*** Ashmead

Fauna: 1 sp., *S. anomalipes* Ashmead, in USA (north to OR and WY).

– Pronotum not evidently separated by constriction from mesoscutum. *Male*: tibiae not abnormally inflated. *Female*: hypopygium in most species shorter 39

39(38) Head and thoracic dorsum with numerous coarse setiferous punctures; propodeum with entire callus (area outside spiracle) convex and setose [metapleuron and part of mesepimeron also setose]; metacoxa dorsally setose and slightly crest-like. *Female*: hypopygium reaching at least three-quarters length of gaster and medially narrowly produced into spine-like process (mucro) (Fig. 50) .... ***Melancistrus*** Graham

Fauna: 1 sp., *M. diplosidis* (Eckel). **Hosts**: unknown, but collected in sap droplets caused by Cecidomyiidae on conifers (*Picea*, *Pinus*).

– Head and thoracic dorsum rarely with numerous coarse punctures (Fig. 392); propodeum with callus, if densely setose, not unusually convex; metacoxa dorsally bare or setose, but if setose coxa not raised into crest. *Female*: hypopygium in most species reaching to about middle of gaster and always without mucro (Fig. 391). [Forewing venation very variable, Figs. 48, 49*a–d*.] .... ***Gastrancistrus*** Westwood (part)

Fauna: at least 60 spp. **Hosts**: gall-forming Cecidomyiidae.

40(17) Flagellum with 7 (Figs. 56, 57, 64) or 8 (Fig. 51) well developed funicular segments and at most 1 anellus or, rarely, flagellar segments gradually shortened towards pedicel without clearly differentiated anellus but then notauli complete and specimen appearing wingless (Fig. 55, *Alloterra*); mesoscutum varied, usually without conspicuous reticulation 41

– Flagellum with at most 6 distinct funicular segments before clava and of these at least the 2 basal segments anelliform and without longitudinal sensilla (absence of sensilla important in case when second anellus or both anelli subquadrate) (Figs. 30, 55, 94, 152), if several basal flagellar segments anelliform then mesoscutum reticulate, and usually notauli incomplete (except some dwarf *Ormocerus*, see couplet 93) 63

41(40) Notauli complete (Figs. 394, 400, 401, 408, 411) or, if incomplete, pronotum large (Fig. 70) and bell-shaped, or profemur strongly enlarged, or specimen short-winged; thoracic dorsum most often without raised reticulation 42

– Notauli incomplete (Figs. 436, 445, 447, 449, 453); pronotum with strongly transverse collar; thoracic dorsum with raised reticulation 154

42(41) Fully winged; marginal vein distinctly thickened, parallel-sided, and only slightly longer than stigmal vein (Fig. 51); flagellum with the 2 basal segments elongate but without longitudinal sensilla; thoracic dorsum punctate-reticulate, without conspicuous setae and with scutellum strongly convex ....
.... PTEROMALINAE, ***Pandelus*** Förster

Fauna: 1 sp., *P. grisselli* Boucek, in USA (CA). **Hosts**: reared from branch of *Umbellularia*; probably on Anobiidae. (See Boucek 1993*b*.)

– Wingless or, if fully winged, marginal vein not distinctly thickened or, if slightly thickened, marginal vein much longer than stigmal vein; flagellum with first segment distinctly anelliform in most species; thorax different 43

43(42) Wingless or, if fully winged, marginal vein longer than stigmal vein (Figs. 63, 64); occiput only rarely with developed horseshoe-like occipital carina (including almost wingless females) 44

– Fully winged, with marginal vein about as long as stigmal vein (Figs. 81, 84); occiput with distinct horseshoe-like occipital carina (Fig. 400) 69

44(43) Fully winged; marginal vein at least 3.5 times as long as stigmal vein, the latter short, curved, and with distinct uncus, hence stigmal vein almost hook-like (Fig. 52); postmarginal vein short; mandibles strong, but narrow, each with 2 large teeth (Fig. 53); thorax usually shiny, although with network of engraved lines and with scattered coarse setiferous punctures; petiole either short and concealed or elongate, parallel-sided, and dorsally with conspicuous sculpture .... see CHRYSOLAMPINAE, **PERILAMPIDAE**

– Fully winged or almost wingless; if winged, marginal vein **either** relatively shorter **or** stigmal and postmarginal veins different; mandibles and thorax different 45

45(44) *Male only*: pronotum convex-subconical, rather long, **and** notauli almost parallel in posterior half of mesoscutum (Fig. 54); flagellum often with funicular segments transverse and becoming gradually smaller towards base, at least several of them anelliform; scutellum with sparse setae; mesoscutum at most weakly shiny, always with fairly dense but fine punctation merging with irregularly rugose, mainly transversely arched reticulation; gaster sessile; fully winged (typical habitus, Fig. 393) .... see **TORYMIDAE**

– *Both sexes*: pronotum and notauli different **or**, **if** pronotum subconical, scutellum and mesoscutum with very dense setiferous punctures; other features also often different; fully winged to almost wingless 46

46(45) Gt_1 large, bell-shaped, and covering more than half length of gaster (Figs. 57, 60); vertex and thoracic dorsum with pairs of conspicuous setae, the setae stronger and longer than the normal setae (Fig. 394); scutellum in most species with frenum clearly delimited (weak in some *Lelaps* and *Netomocera*); metacoxa unusually long, bare, but on dorsal surface at least partly with sculpture forming or suggesting cross-striae (Fig. 395); cercus with very long setae. *Female*: often brachypterous .... DIPARINAE, 47

– Gt_1 not unusually large, always much shorter than half length of gaster; head and thoracic dorsum without conspicuous pairs of stronger setae; scutellum with frenum not separated; metacoxa without cross-striae; cercus with short setae in most species; fully winged 54

47(46) *Female only*: short-winged or appearing wingless 48
– *Both sexes*: fully winged 51

48(47) Flagellum with funicular segments transverse, the first 2 or 3 segments anelliform (Fig. 55); eye small, its height half malar space; ocelli indistinct; mesothoracic dorsum very small, hardly as broad as pronotum and smaller than horizontal propodeum; Gt_1 anteriorly with 2 sublateral longitudinal keels .... ***Alloterra*** Kieffer (part)

Fauna: 1 sp., *A. trilineata* (Yoshimoto), in eastern USA and TX.

– Flagellum with funicular segments subquadrate or oblong, at most with 1 anellus (Fig. 57); eye much larger; ocelli distinct; mesothorax larger, broader than pronotum; Gt_1 anteriorly without keels 49

49(48) Clypeal margin with small but sharp median tooth and with short rounded lobe on either side of tooth (as in Fig. 396); flagellum with first funicular segment longer than pedicel; scutellum with frenal line sometimes obscured by longitudinal striation .... ***Spalangiolaelaps*** Girault

Fauna: 1 sp., *S. argenticoxa* Girault, in USA (FL, MD, MO) [probably a short-winged species of *Lelaps*].

– Clypeal margin without median tooth, the margin either subemarginate, truncate or slightly arcuately produced; flagellum with first funicular segment at most as long as pedicel; scutellum with frenal line distinct 50

50(49) Gaster sessile or nearly so (Fig. 60); body rather broad, with wings more or less reduced; scutellum sometimes with frenal line indistinct ....***Netomocera*** Bouček (part)

Fauna: 1 widespread sp., *N. nearctica* Yoshimoto.

– Gaster on subquadrate petiole (Fig. 57); body fairly slender, almost wingless; scutellum with frenal line distinct .... ***Dipara*** Walker (part)

Key: Yoshimoto (1977). **Fauna**: 2 widespread spp., *D. canadensis* Hedqvist and *D. pedunculata* Yoshimoto.

51(47) Clypeal margin with small median tooth (Fig. 396) (or obtuse-angular tooth in some Neotropical spp.). *Female*: forewing often with spots (Fig. 63) and first funicular segment longer than pedicel. *Male*: flagellum usually with long erect setae (Fig. 62) .... ***Lelaps*** Haliday

Key: Yoshimoto (1977). **Fauna**: at least 6 spp.

– Clypeal margin without median tooth, although margin often produced. *Female*: forewing at most with vague infumation; first funicular segment at most as long as pedicel. *Male*: flagellum with setae variable 52

52(51) *Both sexes*: petiole subtriangular and broader than long. *Female*: flagellum clavate or subclavate. *Male*: antenna long, the flagellum filiform with very short, inconspicuous setae (Fig. 59) .... ***Netomocera*** Bouček, see 50

– *Male only*: petiole at least as long as broad, with sides almost parallel (and light-colored); antenna often different 53

53(52) Petiole at least as long as propodeum and metacoxa dorsally without lamella; flagellar segments distinctly constricted at junction with following segment and with sparse long setae sometimes in whorls (Fig. 58); notauli relatively deep .... ***Dipara*** Walker, see 50

– Petiole rod-like and metacoxa dorsally in apical half with small nail-like lamella (Fig. 61); flagellar segments parallel-sided and with very short setae (Fig. 56); notauli relatively shallow in posterior half of mesoscutum .... ***Alloterra*** Kieffer, see 48

54(46) Legs and antenna very slender. *Female*: mesotarsus 4-segmented, with basitarsus longer than remaining segments combined (Fig. 64). *Male*: flagellum with 1 large anellus, 8 funicular segments, and 2-segmented clava. *Both sexes*: lower face with distinct tentorial pits and laterally with faint groove extending from eye parallel to malar sulcus; mesoscutum with lateral lobe produced posteriorly outside of axilla; prepectus very small, at most about one-third as long as tegula, with upper margin separated by distinct gap from mesoscutum .... MACROMESINAE, ***Macromesus*** Walker

Fauna: 1 sp., *M. americanus* Hedqvist. **Hosts**: Scolytidae in twigs of *Pinus*.

– Legs and antenna in most species not slender. *Female*: tarsi 5-segmented. *Male*: flagellum variable, but with clava 3-segmented or undivided. *Both sexes*: lower face without distinct tentorial pits and without additional grooves; mesoscutum with lateral lobe not produced posteriorly; prepectus always larger than above and usually closely bordering on side of mesoscutum 55

55(54) Postmarginal vein distinctly longer than stigmal vein or wings strongly reduced; notauli usually complete 56

– Postmarginal vein usually not longer than 1.1 times length of stigmal vein, **but** if slightly longer then notauli incomplete. [Always fully winged forms.] 154

56(55) *Male only*: thoracic dorsum with dense rugulose reticulation but setiferous punctures often indistinct; femora not unusually thickened; notauli often shallow; postmarginal vein at most 1.5 times as long as stigmal vein, and marginal vein at least twice as long as stigmal vein; pronotum short, with collar not differentiated .... see EUPELMINAE, **EUPELMIDAE**

– *Both sexes*: thoracic dorsum with conspicuous and dense setiferous punctures **and/or** one or both of profemur and metafemur unusually enlarged (Figs. 66, 68, 71); notauli deep or shallow, in some species incomplete; postmarginal vein often more than twice as long as stigmal vein, and marginal vein at least 3 times as long as stigmal vein (especially if femora not enlarged); pronotum usually longer than half length of mesoscutum (except *Epistenia*, *Amotura*) .... CLEONYMINAE, 57

57(56) Thorax dorsally flat, with thoracic grooves arranged in star-like pattern of lines (Fig. 65), and with pronotum long, in dorsal view separated from mesothorax by distinct constriction; profemur greatly enlarged and ventrally with comb of minute teeth, the comb in outer view partly hidden behind strong oblique bristles (Fig. 66); head with deep ∧-shaped scrobes and with parascrobal area raised into crest having rasp-like sculpture .... ***Oodera*** Westwood

Fauna: 1 unidentified sp. in USA (mid-Atlantic states). **Hosts**: in dead wood of *Gleditsia*, probably on Coleoptera.

– Thorax different, grooves not in star-like pattern of lines (Fig. 67); profemur either not enlarged or without comb and bristles; head with scrobes often different but at least parascrobal area not crest-like 58

58(57) Pronotum very long (Fig. 68) and separated from mesothorax by evident constriction; thorax virtually bare; forewing with 3 dark bands, the basal band small and extending from enlarged base of parastigma having tuft of black bristles; gaster with fine coriaceous sculpture .... ***Heydenia*** Förster

Fauna: 2 spp. **Hosts**: Scolytidae on conifers, especially *Pinus*.

– Pronotum broadly attached to mesothorax and usually much shorter (Figs. 70, 73); thorax with dense short setae; forewing without bands, except some *Cleonymus* with 2 bands; base of parastigma not greatly enlarged and without distinct tuft of bristles; gaster often with strong sculpture 59

59(58) Metafemur greatly enlarged, ovoid, with ventral comb of teeth (Figs. 71, 397); profemur enlarged. *Female*: clava short, often with apical surface collapsed but with distinct, narrow, digit-like process (Fig. 71); pronotum medially extremely short, with longitudinal pale line on sloping part 60

– Metafemur not unusually enlarged, without teeth; profemur fairly slender. *Both sexes*: clava with apex rounded or subacuminate, without digit-like process; pronotum medially not exceptionally short, uniformly pigmented dorsally 61

60(59) Metatibia with 1 or 2 apical spurs (Figs. 71, 397), and with apical margin sinuate; metafemur with teeth in most species small and numerous. *Female*: gaster not greatly elongate, the apical tergum at most slightly longer than wide (Fig. 71) .... ***Amotura*** Cameron

Key: Grissell (1991). **Fauna**: probably 4 spp. **Hosts**: larvae of Coleoptera in dead wood.

– Metatibia without apical spurs (Fig. 72) and with apical margin nearly straight; metafemur with about 5 long, oblique teeth. *Female*: gaster greatly elongate, the apical tergum many times longer than wide .... ***Dryadochalcis*** De Santis

Key: Grissell (1991). **Fauna**: 1 sp., *D. texana* (Brues), in southwestern USA.

61(59) Notauli complete, though shallow over posterior quarter (Fig. 73); scutellum with apex clearly produced over propodeum and without groove along posterior margin; gaster with most terga having coarse, dense punctation and usually with distinct dorsolateral keel (Fig. 398). *Female*: flagellum with apical segments normal, the preclaval segment without process. *Male*: flagellum slender .... ***Epistenia*** Westwood

Key: Hedqvist (1968). **Fauna**: 6 spp. **Hosts**: bees (Apoidea) and some aculeate wasps nesting in dead wood.

– Notauli incomplete (Fig. 70); scutellum with apex not produced but with visible punctate groove along posterior margin; gaster with terga usually shiny but often with transverse sculpture and without dorsolateral keel. *Female*: flagellum with preclaval segment narrowly produced into process along outer side of clava (Fig. 69). *Male*: flagellum different 62

62(61) Eye bare. *Female*: short-winged (Fig. 67); gaster on short petiole; pronotum longer than mesoscutum. *Male*: flagellum with 6 long branches ....***Notanisus*** Walker

Fauna: 1 sp., *N. sexramosus* (Erdös), in USA (MD), apparently introduced from Europe. **Hosts**: *Tetramesa* (Eurytomidae) in grass stems.

– Eye densely setose. *Female*: fully winged; gaster sessile; pronotum at most as long as mesoscutum (Fig. 70). *Male*: flagellum stout, without branches ....***Cleonymus*** Latreille

Fauna: at least 5 spp. **Hosts**: Anobiidae, Buprestidae, Curculionidae, Bostrychidae, and other Coleoptera in dead wood, or bees (Apoidea) nesting in holes in wood.

63(40) Propodeum with spiracle near midlength (Figs. 78, 399); torulus below lower margin of eye; flagellum slender, with 3 anelli and 5 funicular segments; forewing very narrow (Fig. 74) and often shortened, with marginal vein very long and extending straight out from submarginal vein; mandibles narrow, each with 2 teeth; notauli complete; body with delicate sculpture; [forewing apex with very long marginal setae]. *Male*: flagellum with each segment beyond anelli often having whorl of long setae .... CEINAE, 64

– Propodeum with spiracle much nearer anterior than posterior margin (Figs. 401, 404, 406); torulus usually higher on face; flagellum in most species quite different; forewing rarely narrow but, if so, then venation with distinct curve at junction of submarginal and marginal veins; right mandible with at least 3 (or 4) teeth; body with sculpture usually not delicate. *Male*: flagellum rarely with whorls of long setae 65

64(63) Mesopleuron with posterior margin raised above level of metapleuron (Figs. 78, 399). *Female*: antenna with radicle less than twice as long as broad and at least some funicular segments less than 1.4 times as long as broad (Figs. 77, 79); forewing often broadly infumate. *Male*: flagellum with basal whorl of long setae on all 5 funicular segments (Fig. 76) .... ***Spalangiopelta*** Masi

Key: Darling (1991). **Fauna**: 5 spp. **Hosts**: *S. apotherisma* Darling & Hanson reared from egg mass of *Lymantria dispar* L. (Lymantriidae) [1 sp. in Europe reared from Agromyzidae leafminer on *Cakile maritima*].

– Mesopleuron with posterior margin virtually in same plane as metapleuron. *Female*: antenna with radicle more than 3 times as long as broad and funicular segments about twice as long as broad (Fig. 75); forewing with 2 fuscous bands (Fig. 74). *Male*: flagellum with short regular setae .... ***Cea*** Walker

Fauna: 1 Holarctic sp., *C. pulicaris* Walker. **Hosts**: Agromyzidae leafminer on *Peucedanum*.

65(63) Head with smoothly curved, ∩-shaped occipital carina (Figs. 80, 400) as, e.g., in most Torymidae 66

– Head without occipital carina or carina in form of moderate arch (sometimes head with blunt obtuse-angular edge between vertex and occiput or nearer to occipital foramen) 70

66(65) Notauli complete (Figs. 80, 86, 89, 93, 401); occipital carina strongly arched and continuing ventrally on lateral part of occiput 67

– Notauli incomplete (Figs. 445, 447, 449, 453); occipital carina usually replaced by weakly arched subcarinate margin or fold having traces of reticulation (Figs. 304, 450) 184

67(66) Torulus above lower margin of eye (Fig. 116); forewing with marginal vein distinctly longer than stigmal vein, sometimes infumate; thoracic dorsum reticulate and with regular thin setae; scutellum with carinate posterior rim 68

– Toruli below lower margin of eye (Fig. 84); forewing with marginal vein not longer than stigmal vein, hyaline; thoracic dorsum nearly smooth and usually partly with longer setae, on scutellum often almost bristly; scutellum rounded posteriorly, without carinate rim .... ASAPHINAE, 69

68(67) Flagellum with 3 strongly transverse anelli and 5 funicular segments (Fig. 116); face with anterior margin produced just above mouth, arcuate; gena short and with depression at mouth corner; mesoscutum with raised reticulate sculpture; scutellum with apex almost vertical, not produced; frenum about one-quarter length of scutellum; propodeum with transverse costula; forewing hyaline .... ***Toxeumella*** Girault, see 101

– Flagellum with 2 anelli and 6 funicular segments; face with anterior margin not produced just above mouth, with indentations just lateral to small clypeus; gena convex; mesoscutum with partly engraved reticulation (Fig. 401); scutellum with apex produced into flat rim over metanotum; frenum large, medially over one-third length of scutellum; propodeum without costula; forewing infumate (Fig. 81) [stigmal vein with long uncus] .... ***Hemadas*** Crawford (part)

Fauna: 1 sp., *H. nubilipennis* (Ashmead), in Canada and northern USA. **Hosts**: phytophagous, producing stem galls on *Vaccinium* (Ericaceae).

69(43, 67) Flagellum with first segment anelliform and second segment subquadrate or slightly oblong (Fig. 83); scutellum finely sculptured, with frenal groove shallow; gaster subsessile (Fig. 82); ovipositor sometimes (in *H. corvus*) protruding .... ***Hyperimerus*** Girault

Fauna/Hosts: 2 spp., *H. corvus* Girault (Nearctic) on Neuroptera (e.g., *Chrysopa* and *Hemerobius*) and *H. pusillus* (Walker) (Holarctic) in eastern Canada (NB, NS) on *Psylla* (Psyllidae).

– Flagellum with 2 or more basal segments anelliform or (some males) at least second segment without longitudinal sensilla; scutellum with frenum smooth and bare, frenal line groove-like or formed by row of deep punctures; ovipositor not unusually protruding (Fig. 84) .... ***Asaphes*** Walker

Fauna: at least 3 spp. **Hosts**: hyperparasites of Aphididae, mainly through Aphidiinae (Braconidae).

70(65) Fully winged or nearly so, with venation fully developed 71

– Short winged, with wing stumps generally not exceeding middle of gaster .... (only PTEROMALINAE), 309

71(70) Notauli clearly complete, i.e., reaching posterior margin of mesoscutum, but sometimes very shallow posteriorly and then visible only in certain lights (Figs. 408, 411, 413, 416) 72

– Notauli incomplete, not clearly traceable to posterior margin of mesoscutum, at most indicated only by slight difference in meshes of reticulation (Figs. 445, 447, 449, 453) 124

Note: marginal cases will run either way.

72(71) Clypeal margin with at least slightly asymmetric teeth, the teeth at least slightly different [usually with 2 narrow approximated teeth on left side separated by deep incision from 1 broader tooth on right side (Figs. 90, 402, 412), but sometimes with 2 teeth of left side more or less fused (Fig. 407)]; scutellum with frenum set off by distinct sulcus or row of punctures (Figs. 86, 411, 413, 414); body green, often brightly so, or bluish, the thorax generally with fine reticulation .... most Miscogastrini, 73

– Clypeal margin symmetric (Figs. 420, 425, 429, 438) **or** with only 1 slightly asymmetric, convex projection (Fig. 424, *Plutothrix*); other characters in part different 91

73(72) Pronotal collar margined with sharp, straight, mostly fine, and smooth transverse carina (Figs. 86, 88); petiole hardly to clearly longer than broad; forewing with stigma small (Fig. 86) 74

– Pronotal collar not smoothly carinate, the pronotum rounded (Figs. 103, 408) or, if with angular margin, the margin reticulate (*Callimerismus*, see couplet 79) (Figs. 89, 91); petiole long or short, but if long then forewing with stigma usually enlarged (Figs. 98, 100) 75

74(73) Forewing almost entirely setose except for small speculum behind parastigma (Fig. 86); petiole hardly longer than broad .... ***Ardilea*** Graham

Fauna: 1 sp., *A. convexa* Graham, in Greenland, Canada (LB), and USA (AK).

– Forewing with basal cell mainly bare and with large speculum beyond basal setal line (Fig. 87); petiole distinctly elongate (Fig. 88) .... ***Merismus*** Walker

Key: Heydon and Grissell (1988). **Fauna**: 2 spp., *M. lasthenes* (Walker) in USA (AK), and the widespread *M. megapterus* Walker. **Hosts**: Agromyzidae associated with sturdy herbaceous plants.

75(73) Notauli posteriorly becoming very shallow and hardly visible; scutellum with frenal line a shallow groove; pronotum with horizontal collar indicated, though usually not distinctly set off from sloping neck (Fig. 408); propodeum convex medially; forewing with stigma small (Fig. 89) 76

– Notauli fairly deep and mostly broad furrows (Fig. 92); scutellum with frenal line mostly conspicuous; pronotum sloping, collar not indicated (Figs. 411, 413); propodeum often not convex medially; forewing with stigma often large 82

76(75) Flagellum with at least the 3 basal segments very short, anelliform (Fig. 85). *Male*: mouthparts enlarged (as in *Halticoptera*, Fig. 410) .... ***Halticopterina*** Erdös

Key: Andersen (1990). **Fauna**: 3 spp. in USA (PA, and widespread in western states). **Hosts**: probably Agromyzidae on herbaceous plants, 1 sp. on black locust, *Robinia pseudacacia*.

– Flagellum with 2 anelli and 6 funicular segments. *Male*: mouthparts enlarged or not 77

77(76, 120, 124) Costal cell with basal half bare; propodeum subhorizontal but convex and irregularly sculptured or partly reticulate, without median carina or with carina incomplete; mesosoma elongate, usually much more than 1.4 times as long as broad; scutellum with frenal line distinct. [Petiole transverse or subtriangular; mandibles each with 4 teeth (Fig. 90).] .... ***Rhicnocoelia*** Graham

Key: Heydon (1989*b*). **Fauna**: possibly 3 spp., widespread in southern Canada and USA. **Hosts**: probably Diptera.

– Costal cell basally on underside with at least sparse row of setae; propodeum in most species with median carina and with shiny, or shallowly to strongly reticulate, convex submedian areas; mesosoma generally shorter; scutellum with frenal line weak or absent 78

78(77) Propodeum with submedian area strongly reticulate; clypeal margin with 3 asymmetric teeth; pronotum in lateral view angular between collar and neck (Fig. 89); left mandible with 3 teeth and right mandible with 4 teeth 79

– Propodeum with submedian area shiny to moderately reticulate (Figs. 408, 409) or rarely coarsely rugose, the submedian area delimited by plica laterally and transverse carina posteriorly; clypeal margin usually with 2 or 3 more or less asymmetric teeth; pronotum in lateral view angular or rounded between collar and neck; mandibles each with 4 teeth 80

79(78) Gt_1 with posterior margin virtually straight; petiole less than 1.4 times as long as broad and anteroventrally braced with transverse flange .... ***Callimerismus*** Graham

Fauna: 1 sp., *C. inusitatus* Heydon (1989*b*), in eastern USA.

– Gt_1 with posterior margin sublaterally sinuous and medially distinctly produced (Fig. 91); petiole at least twice as long as broad, with median and lateral carinae, anteriorly slightly tapered but ventrally without anterior brace .... ***Collentis*** Heydon

Fauna: 1 sp., *C. latipennis* (Ashmead), in Canada (NT) and USA (CO).

80(78) Clypeal margin either with 1 asymmetric tooth (Fig. 403) or with 3 teeth, but then teeth usually sharp and with only narrow gap between them (Fig. 402); antenna usually black (scape dark metallic), with flagellum filiform and having conspicuous white longitudinal sensilla .... ***Thinodytes*** Graham (part)

Key: Heydon (1995*a*). **Fauna**: 5 spp. **Hosts**: Agromyzidae and other Diptera mining plant leaves or grass stems.

– Clypeal margin usually with 2 distinct teeth having broad gap between them (Figs. 405, 407); antenna with scape pale, with flagellum brown and longitudinal sensilla inconspicuous 81

81(80) Torulus above lower margin of eye (Fig. 405); petiole without median carina and with anterolateral corners sharp and greatly enlarged (Figs. 146, 406); femora dark; marginal vein at least twice as long as stigmal vein. *Male*: palpi slender and dark .... ***Mauleus*** Graham, see 120

– Torulus at or below lower margin of eye; petiole usually with median carina and with anterolateral corners not so greatly expanded (Fig. 409); femora and tibiae mostly pale; marginal vein about twice as long as stigmal vein. *Male*: palpus and/or stipes more or less enlarged and yellow (Fig. 410). [If flagellum without anelli and with 7 funicular segments see *Andersena*, couplet 24.] .... ***Halticoptera*** Spinola (part)

Fauna: at least 10 spp. **Hosts**: Diptera boring in plants.

82(75) Frenum with coarse longitudinal costulae or rugae and at least medially without reticulation (Fig. 411); scutellum anteriorly sometimes with weak median groove; petiole strongly transverse to quadrate (if quadrate then dorsally with coarse rugosity), in most species with transverse crest anteriorly, and sides diverging forwards (Fig. 92); forewing with large speculum and with stigma having lower margin mostly emarginate (Figs. 93*a–c*) .... ***Lamprotatus*** Westwood, 83

– Frenum with much finer sculpture, mostly reticulate (Fig. 413) or, if rarely with weak costulae, petiole quadrate to oblong with deep regular reticulation and forewing with stigma very large (Fig. 100); gaster either sessile or on petiole of various forms but different from above; forewing with or without speculum and with stigma variable in size and shape 84

83(82) Flagellum with 7 well separated funicular segments and 2-segmented clava .... ***Lamprotatus*** (***Skeloceras*** Delucchi)

Fauna: several spp.

– Flagellum with 6 funicular segments and 3-segmented clava (Fig. 92) .... ***L.*** (***Lamprotatus*** Westwood)

Fauna: at least 5 spp., mainly northern. **Hosts**: larvae of Diptera boring stems of sturdy herbaceous plants.

84(82) Petiole strongly transverse, subtriangular or, if subquadrate, dorsally more or less shiny (Fig. 413) with some transverse striae and anteriorly often with fine arcuate or ∧-like carina; forewing with stigma often small or narrow (Figs. 95, 96, 99) 85

– Petiole elongate (Figs. 414, 415) or, if only about as long as broad, dorsally with distinct, mostly reticulate sculpture; forewing with stigma often large (Figs. 98, 100, 103) 87

85(84) Forewing without speculum, extensively setose in basal third (Fig. 99); petiole subquadrate, dorsally almost smooth and anteriorly with fine arcuate carina; mandible sometimes with deep emargination on ventral margin (as in Fig. 97) .... ***Xestomnaster*** Delucchi

Fauna: at least 3 spp. (belonging to a species group different from European species), widespread.

– Forewing with distinct, broad speculum (as in Fig. 100); petiole often strongly transverse; mandible without deep emargination on ventral margin .... ***Seladerma*** Walker, 86

86(85) Flagellum with each funicular segment having 2, sometimes 3 irregular, rows of longitudinal sensilla; forewing with stigma usually having concave lower margin (Figs. 96 *a–c*) .... ***S.*** (***Seladerma*** Walker)

Fauna: at least 15 spp., mostly in mountains and northern.

– Flagellum with each funicular segment having only 1 row of longitudinal sensilla (Fig. 94); forewing with stigma usually having rounded lower margin (Figs. 95*a–c*) .... ***Seladerma*** (***Isoplata*** Förster)

Fauna: probably more than 10 spp.

87(84) Petiole stout and parallel-sided, dorsally with almost uniform deep reticulation or, if distinctly elongate, petiole rugulose-reticulate (Figs. 101, 102, 414); mandible with sinuate ventral margin 88

– Petiole not stout, elongate and more or less tapering anteriorly (Figs. 104, 415), with sculpture often weak; mandible sometimes with deeply emarginate ventral margin (Fig. 97) 89

88(87) Forewing without speculum or speculum strongly reduced, either indicated by narrow strip along basal fold/setal line or by small bare area behind parastigma, the speculum thus separated from basal vein; stigma of medium size, with ventral margin usually emarginate .... ***Stictomischus*** Thomson

Fauna: at least 2 spp.

– Forewing with speculum large and broadly bordering basal fold/setal line; stigma large, its height more than half distance to anterior margin of wing (Fig. 100), with ventral margin of stigma usually broadly rounded .... ***Sphaeripalpus*** Förster

Fauna: several uncommon spp.

89(87) Forewing with stigma subtriangular (Fig. 103); petiole densely reticulate, at least 1.5 times as long as broad (Figs. 104, 415); Gt_1 with posterior margin indented medially; prepectus anteriorly without vertical carina .... ***Miscogaster*** Walker

Fauna: several rather rare spp.

– Forewing with stigma rounded (Fig. 98); petiole shorter or, if as long as above, dorsally shiny with very weak sculpture; Gt_1 with posterior margin entire; prepectus anteriorly with vertical carina .... ***Glyphognathus*** Graham, 90

90(89) Mandible with deep emargination on ventral margin (as in Fig. 97) .... *G.* (***Glyphognathus*** Graham)

Fauna: 1 unidentified sp. in USA (AK).

– Mandible without emargination on ventral margin .... ***Glyphognathus*** (***Xestognathus*** Kamijo)

Fauna: 1 unidentified sp. in Canada (MB).

91(72) Marginal vein not or at most only slightly longer than stigmal vein (Fig. 105) [stigmal vein more or less clavate]; gaster sessile or on short, anteriorly narrowing petiole 92

– Marginal vein at least 1.3 times as long as stigmal vein (in most species much longer); gaster subsessile or on clearly elongate petiole 94

92(91) Marginal vein distinctly broadened (Fig. 105); scutellum anteriorly acuminate, narrowly touching mesoscutum; gaster subpetiolate, with Gt_1 longer than broad and much narrower than remaining terga (Fig. 416); pronotal collar margined with sharp carina; face extensively striate (Fig. 106) .... ***Coruna*** Walker

Fauna: probably only 1 sp., the widespread, Holarctic *C. clavata* Walker. **Hosts**: hyperparasite of Aphididae through Aphidiinae (Braconidae).

– Marginal vein not broadened; scutellum broadly touching mesoscutum; gaster sessile, with Gt_1 as broad or broader than long and as broad as remaining terga; pronotum with at most weak median carina; face not striate 93

93(92) Clypeal margin with broad angular median tooth (Figs. 138, 424); antenna long, with funicular segments oblong; notauli deep; gaster much longer than mesosoma; forewing venation as in Fig. 108 .. .. ***Plutothrix*** Förster, see 112

– Clypeal margin subtruncate; antenna very short, with funicular segments transverse; notauli often shallow and broad; gaster usually shorter than mesosoma; forewing venation as in Fig. 107 .... ***Ormocerus*** Walker

Fauna: at least 4 spp. **Hosts**: in galls on *Quercus*; adults in spring.

94(91) Head and thorax almost smooth, black, nonmetallic, and dorsally moderately depressed; gaster sessile, broadly oval, flat, and with most terga having posterior margins excised medially; pronotum with large quadrate collar (Fig. 111); flagellum short, with 3 anelli; toruli nearer to eyes than to each other; profemur and protibia broad. [*Male*: antenna with scape expanded, foliaceous.] .... ***Morodora*** Gahan

Fauna: 1 sp., *M. armata* Gahan, in Canada (BC) and USA (CA, MT, UT). **Hosts**: Calliphoridae in bird nests.

– Head and thorax mostly with distinct reticulation, usually with metallic color, and not depressed; gaster petiolate in some species, short or long, with posterior margins of terga usually not excised; pronotum short, not quadrate; antenna and legs different, toruli nearer to each other than to eyes 95

95(94) Gaster sessile or petiole, if visible, subtriangular and generally smooth 96

– Gaster either on long petiole or, if petiole subtransverse, the petiole with subparallel sides and dorsally distinct sculpture (either with some reticulation or with coarse longitudinal costulae or rugae). [Probably all species parasitic on Diptera.] 114

96(95) *Male only*: marginal vein at least 3.5 times as long as stigmal vein, and postmarginal vein short; pronotum usually large, collar gradually merging with neck, without edge (Fig. 54); gaster sessile; head and thorax with dense sculpture consisting of fairly dense setiferous punctures merging with irregularly rugulose, mainly transverse reticulation; petiole inconspicuous but metacoxa very large (typical habitus, Fig. 393) .... see **TORYMIDAE**

– *Both sexes*: marginal vein at most 3 times as long as stigmal vein, and postmarginal vein sometimes long; other characters in part different 97

97(96) Torulus above middle of face; lower face broadly concave; clypeal margin bilobed, with deep median incision; antenna (Fig. 112) with pedicel longer than combined length of first 2 flagellar segments; pronotum about as broad as mesoscutum; notauli deeper posteriorly than anteriorly; scutellum at anterior margin broader than axilla; metafemur very stout .... ***Perniphora*** Ruschka

Fauna: 2 spp., *P. americana* Miller in Canada (NB) and USA (ME, NH, NY, WA), and the Holarctic *P. robusta* Ruschka in Canada (BC). **Hosts**: *Trypodendron* and *Dendroctonus* (Scolytidae) in logs of *Betula* and conifers.

– Torulus below middle of face; lower face not concave; clypeal margin different; antenna with pedicel shorter; pronotum much narrower than mesoscutum; notauli deeper anteriorly than posteriorly; scutellum at anterior margin narrower than axilla in most species; metafemur not stout 98

98(97) Clypeal margin with 3 short lobes and torulus above lower margin of eye (Figs. 114, 115); head and thorax rather shiny, with fine engraved-reticulate sculpture; pronotum without distinct collar; axillae distinctly advanced; propodeum without costula; stigmal vein often curved and postmarginal vein longer than marginal vein (Fig. 113); flagellum with 2 anelli and sometimes very short (Fig. 114); gaster sessile .... ***Nodisoplata*** Graham

Fauna: at least 2 spp., including the Holarctic *N. affinis* (Walker); northern or in mountains in spring. **Hosts**: on *Salix*.

– Clypeal margin without median tooth or lobe except if torulus below lower margin of eye; head and thorax with distinct, mostly raised-reticulate sculpture; pronotum with distinct collar; axillae not advanced; propodeum often with angular costula; stigmal vein almost straight and postmarginal vein at most as long as marginal vein; flagellum with 2 or 3 anelli and longer [although scape sometimes not reaching anterior ocellus (in *Toxeumella*)] 99

99(98,183) *Female*: flagellum with 3 strongly transverse anelli and 5 funicular segments; torulus above lower margin of eye 100

– *Both sexes*: flagellum either with 2 anelli and 6 funicular segments or, if third flagellar segment anelliform, toruli distinctly below lower margin of eye 102

100(99) Pronotum sloping from thin posterior margin, without collar. *Female*: ovipositor sheaths protruding, clavate; hypopygium very long; metacoxa slender and almost vertical relative to thorax (Fig. 117). *Male*: marginal vein and angular parastigma broadened and bristly (Fig. 118) .... see ***Aepocerus*** Mayr, **AGAONIDAE**

– Pronotum with steep neck and distinct collar. *Female*: ovipositor not protruding; hypopygium not long; metacoxa not unusually slender and oblique relative to thorax. *Male*: venation not broadened and not bristly 101

101(100) Lower face with mouth margin produced in broad arch (Fig. 116) and with broad, poorly delimited clypeus; gena short and with deep depression at mouth corner; occiput distinctly margined, but margin sometimes weak medially; flagellum with anelli very short. *Female*: gaster much shorter than mesosoma and subsessile .... ***Toxeumella*** Girault (part)

Fauna: 1 sp., *T. albipes* Girault, in USA (FL) [widespread in Neotropical region]. **Hosts**: parasite of Lepidoptera, e.g., *Opsiphanes* (Brassolidae), or hyperparasite through *Apanteles* (Braconidae).

– Lower face with mouth margin not produced (Fig. 347), the clypeus either with shallowly emarginate margin or low bump medially and with radiating striae; gena without depression; occiput not margined; flagellum with anelli not unusually short. *Female*: gaster longer than head plus mesosoma, subconical or lanceolate and sessile .... ***Conigastrus*** Bouček. see 283

102(99) Clypeal margin with narrow median tooth and small tooth on either side (Fig. 403); notauli posteriorly very shallow but complete: gaster on very short petiole, flat and relatively short (Fig. 404), and with Gt_1 longer than following 2 terga combined .... ***Thinodytes*** Graham, see 80

– Clypeal margin either with very broad median tooth or margin more or less truncate; notauli posteriorly more distinct; gaster in most species different, with Gt_1 relatively much shorter 103

103(102) Torulus distinctly below lower margin of eye (Fig. 110); thoracic sculpture weak; body at most 2 mm long 104

– Torulus close to or above lower margin of eye; thoracic sculpture sometimes strong; body often longer 105

104(103) *Female*: flagellum slender, with 2 anelli and 6 quadrate to oblong funicular segments; clypeal margin arched (Fig. 110) or subtruncate; notauli ending very close to scutoscutellar sutures at posterior margin of mesoscutum (Figs. 417, 418). [Forewing venation as in Fig. 109.] .... ***Ammeia*** Delucchi

Fauna: probably several spp., including the almost cosmopolitan *A. pulchella* Delucchi in USA (CA, CO, IA, TX).

– *Female*: flagellum clavate, with third segment sometimes anelliform and remaining segments subquadrate or transverse (Fig. 120); clypeal margin with 3 small lobes (Figs. 120, 121); notauli touching posterior margin of mesoscutum lateral to scutoscutellar sutures (Fig. 119) .... ***Tricyclomischus*** Graham

Fauna: 2 spp., including *T. algonquinus* Heydon (see Heydon and Bouček 1992).

105(103) Face with scrobes deep and narrow, and with distinct ridge between toruli; clypeal margin deeply incised; propodeum with transverse costula; Gt_1 with posterior margin broadly emarginate (Fig. 124). *Male*: stigmal vein capitate (Fig. 123). *Female*: stigmal vein slender (Fig. 122) .... ***Ficicola*** Heydon (part)

Fauna: 1 sp., *F. flora* (Girault), in USA (FL). **Hosts**: in figs of *Ficus aurea*. (See Heydon and Bouček 1992.)

– Face with scrobes not narrow and without ridge between toruli; clypeal margin not deeply incised; propodeum without costula; Gt_1 with posterior margin straight or produced. *Both sexes*: stigmal vein not so capitate 106

106(105) Propodeum with subparallel plicae, anteriorly each plica far from spiracle (Fig. 126); thoracic dorsum shiny, but with delicate reticulation and with conspicuous sparse setiferous punctures; scutellum with anterior margin straight. *Male*: flagellum stout (Fig. 127). [Forewing venation as in Fig. 125.] .... **Huberina** Bouček

Fauna: 1 sp., *H. betuleti* Bouček (1993*b*), in Canada (NS).

– Propodeum with plicae either strongly converging and (as usual) close to spiracle or plicae incomplete or indistinct; thoracic dorsum more or less dull from reticulation, but without conspicuous setiferous punctures; other characters in part different 107

107(106) Scutellum with anterior margin broader than axilla; notauli shallow but clearly complete; pronotum very short; prepectus small, shorter than tegula; propodeum with median area, including distinct nucha, reticulate. [Clypeus, antenna, and forewing as in Figs. 129–131.] .... **Lenka** Bouček

Fauna: 1 sp., *L. smithi* Bouček (1993*b*), in USA (VA).

– Scutellum with anterior margin much narrower, its sides anteriorly converging, hence more or less ∧- or ∩-shaped; notauli fairly deep and groove-like; pronotum moderately to unusually long; prepectus usually large (small in *Arriva*); propodeum different, without nucha 108

108(107) *Female* (male unknown): scutellum strongly convex, subconical (Fig. 128), anteriorly hardly reaching mesoscutum, hence pointed; eye densely setose; notauli very broad and deep; propodeum without carinae, shiny, and almost conically tapering into short, shiny nucha; gaster about as long as mesosoma; antenna with most funicular segments subquadrate .... **Arriva** Bouček

Fauna: 1 sp., *A. abyssa* Bouček (1993*b*), intercepted in USA (TX) from Mexico [also in Guatemala].

– *Both sexes*: scutellum not unusually convex, with anterior margin broadly touching mesoscutum; eye not densely setose; notauli sometimes deep but not very broad; propodeum different, with plicae at least partly traceable, and without shiny nucha; gaster usually long; antenna with funicular segments elongate (except some *Plutothrix*) 109

109(108) Prepectus anteriorly without carina or ridge, flat, and with raised reticulate sculpture (Figs. 132, 419); lower face with deep, hole-like tentorial pits; clypeal margin truncate or nearly so (Fig. 420) 110

– Prepectus anteriorly with vertical ridge or carina (Figs. 136, 423), the triangular surface posterior to ridge partly concave (sometimes difficult to see if densely setose), usually irregularly alveolate; lower face with tentorial pits often rather shallow, indicated only by deepening of upper clypeal corners (Fig. 424); clypeal margin usually with broad median tooth (Fig. 138), the tooth sometimes slightly asymmetric, but rarely margin arcuate or straight 112

110(109) Scutellum with frenal groove close to posterior margin (Fig. 422) and in middle mostly with fine longitudinal reticulation often merging with striation .... ***Platygerrhus*** Thomson

Fauna: 4 spp. **Hosts**: Coleoptera, probably mainly Anobiidae, in twigs.

– Scutellum with frenal groove well removed from posterior margin (Figs. 135, 139, 421), and not longitudinally striate 111

111(110) Pronotum with distinct horizontal collar (Fig. 132), in dorsal view more than half as long as broad (Fig. 421). *Female*: clava apically with subterminal micropilose area (Fig. 133); Gt_1 with posterior margin subangularly produced medially (Figs. 134, 135). *Male*: gaster on smooth subconical petiole (Fig. 134) .... ***Gastracanthus*** Westwood

Fauna: 1 sp., *G. conicus* (Girault). **Hosts**: in dead wood, including tree stumps with bracket fungi.

– Pronotum without collar, sloping immediately from posterior margin, dorsally fairly short and with neck slightly saddle-like and fairly short (Fig. 139). *Female*: clava apically without micropilose area; Gt_1 with posterior margin almost straight. *Male*: metasoma subsessile .... ***Janssoniella*** Kerrich

Fauna: 3 spp. **Hosts**: Ciidae and Braconidae in dead wood attacked by bracket fungi.

112(109) Forewing in basal third extensively bare, in particular dorsal surface with speculum (Fig. 137); pronotum with collar often separated by distinct cross-edge; prepectus bare in most species (Fig. 423). *Male*: flagellum moderately long or short, in most species with conspicuous erect setae or at least with distinct setation. [Clypeal margin with angular tooth, Figs. 138, 424.] .... ***Plutothrix*** Förster (part)

Fauna: 10 spp. **Hosts**: probably Anobiidae, Cerambycidae, and possibly Ciidae, developing in dead wood attacked by fungi.

– Forewing more extensively setose, without speculum or, if present, speculum strongly reduced; pronotum usually without distinct edge; prepectus usually setose. *Male*: flagellum very long and appearing almost bare 113

113(112) Clypeal margin with distinct rectangular to obtuse-angular tooth (Fig. 140); upper face with narrow pit in middle of scrobal depression; body dorsally mainly dark to bluish green, or partly bronze .... ***Trigonoderus*** Westwood

Fauna: probably 3 spp. **Hosts**: some spp. reared from dead branches and twigs containing larvae of Anobiidae, Cerambycidae, Scolytidae, and perhaps other wood-boring Coleoptera.

– Clypeal margin almost straight, slightly produced in arch (Fig. 141); upper face without distinct pit in scrobal depression; body often with vivid metallic colors .... ***Ogloblinisca*** Hedqvist

Fauna: 1 sp., *O. americana* Hedqvist, in eastern North America.

114(95) Clypeal margin with distinct median tooth or, if with 3 teeth (Figs. 148, 425), the lateral teeth sometimes weak 115

– Clypeal margin without median tooth, either with 2 teeth, or truncate, or slightly arched to subangular, but without narrow median tooth (Figs. 145, 149, 155) 118

115(114) Propodeum coarsely and irregularly rugose-alveolate (Figs. 144, 426); petiole dorsally with longitudinal ridges or rugae and usually not longer than broad; pronotum usually with transverse carina or edge, with broad shiny strip behind carina or edge 116

– Propodeum densely reticulate or weakly sculptured, but with median carina and plicae indicated (Fig. 147); petiole often longer than broad and reticulate or slightly rugulose; pronotum dorsally reticulate, with distinct edge but this not carinate, the shiny area reduced to narrow line along posterior margin 117

116(115) Pronotum dorsally carinate; Gt_1 covering less than half median length of gaster and with posterior margin broadly emarginate (Figs. 142, 143); Gt_2 large. *Male*: palpi greatly enlarged, dark (Fig. 427) .... ***Cyrtogaster*** Walker (part)

Key: Heydon (1989*a*). **Fauna**: 7 spp. **Hosts**: puparia of Diptera boring in leaves, stems, and seeds of herbaceous plants.

– Pronotum without transverse carina (Fig. 144); Gt_1 covering most of length of gaster and with posterior margin not emarginate; Gt_2 very short. *Male*: palpi not enlarged .... ***Callicarolynia*** Heydon

Fauna: 1 sp., *C. eruga* Heydon (1989*a*). **Hosts**: puparia of *Odontomyia pubescens* (Day) (Stratiomyidae).

117(115) Pronotal collar in dorsal view much longer than lateral lobe of mesoscutum and with anterolateral corner right-angled (Fig. 147); Gt_1 covering most of length of gaster and with posterior margin deeply emarginate (Fig. 147), the sides of emargination sinuate; clypeal margin with 3 teeth, the middle tooth sometimes weak (Fig. 148) .... ***Kazina*** Bouček

Fauna: 1 sp., *K. procera* Bouček (1993*b*), in USA (FL).

– Pronotum much shorter, with anterolateral corner obtuse-angular and/or rounded (Fig. 428); Gt_1 shorter and with posterior margin almost straight (Fig. 172); clypeal margin with 3 teeth, middle tooth the strongest and broad (Fig. 429) .... ***Bubekia*** Dalla Torre, see 140

118(114) Gt_1 large, with long sides and posterior margin dorsally broadly and deeply emarginate (Fig. 151); torulus partly below lower margin of eye; clypeus delimited by distinct groove and with apical margin shallowly emarginate (Fig. 149); vertex flat and slightly sloping forwards. *Male*: mesotarsus partly black (Fig. 150). *Female*: antenna as in Fig. 152...... ***Vespita*** Bouček

Fauna: 1 sp., *V. woolleyi* Bouček (1993*b*), in USA (FL) and Mexico (Jalisco).

– Gt$_1$ with sides not long, hence with posterior margin not appearing broadly and deeply emarginate; torulus often above lower margin of eye; clypeus different, never delimited by groove; vertex convex. *Male*: mesotarsus yellowish. *Female*: antenna different 119

119(118) Clypeal margin with 2 strong teeth separated by deep incision (Figs. 145, 438); petiole anteriorly with sharp corners 120

– Clypeal margin without deep median incision (Fig. 155), at most with shallow emargination; petiole often different 121

120(119) Torulus distinctly above lower margin of eye (Figs. 145, 405); petiole longer than broad, with each side gradually expanding into sharp anterolateral tooth (Fig. 406); Gt$_1$ with posterior margin strongly sinuate lateral to conspicuous median incision (Fig. 146) .... ***Mauleus*** Graham (part)

Key: Heydon (1995*a*). **Fauna/Hosts**: 2 spp., *M. iligneus* Heydon on *Phytomyza ilicicola* Loew (Agromyzidae), and *M. venetus* Heydon.

– Torulus at or below lower margin of eye; petiole, if longer than broad, with sides subparallel or tapering anteriorly; Gt$_1$ with posterior margin almost straight, although usually with small median notch 77

121(119) Gt$_1$ and Gt$_2$ covering at least half of gaster, with both terga about equally long, and with Gt$_2$ much longer than Gt$_3$ (Fig. 189); clypeal margin slightly produced in arch; pronotal collar with blunt edge, not carinate. [Notauli posteriorly very shallow; scutellum with frenal groove obliterated.] .... ***Polstonia*** Heydon, see 145

– Gt$_1$ either covering most of gaster and much longer than Gt$_2$ (Figs. 153, 154) or Gt$_2$ about as long as Gt$_3$; clypeal margin often different (e.g., Fig. 155); pronotum in most species carinate 122

122(121) Gena with large depression extending nearly to eye; petiole more than twice as long as broad; notauli very shallow in posterior half; scutellum broadly touching mesoscutum (Fig. 153) and frenal line usually indistinct; body black or nearly black .... ***Cryptoprymna*** Förster

Key: Heydon (1988*a*). **Fauna**: 2 spp. **Hosts**: pupae of Syrphidae.

– Gena without depression (Fig. 155) or, if present, depression extending at most halfway to eye; petiole usually only about as long as broad; notauli deep throughout; scutellum narrowly touching mesoscutum and with distinct, punctate frenal line; body sometimes strongly metallic, at least in patches on head and mesoscutum 123

123(122) Mesosoma relatively slender, with thoracic dorsum from collar edge to dorsellum at least 1.5 times as long as broad; pronotal collar not very short and anterior margin sharply carinate; propodeum reticulate and with coarse rugae, at least posteriorly (Fig. 430); scutellum without fovea .... ***Toxeuma*** Walker

Key: Heydon and Grissell (1988). **Fauna**: at least 5 spp. **Hosts**: unknown, but associated with some insects in seeds of grasses.

– Mesosoma relatively plump, with thoracic dorsum from collar edge to dorsellum only about 1.2 times as long as broad; pronotal collar very short and anterior margin without carina; propodeum between plicae almost smooth (Fig. 431). [Scutellum with central fovea in *N. scutellaris* (Fig. 154).] .... ***Notoglyptus*** Masi

Key: Heydon (1988*b*). **Fauna**: 5 spp., including the cosmopolitan *N. scutellaris* (Dodd & Girault). **Hosts**: probably some small Diptera.

124(71) Clypeal margin at least slightly asymmetric, with 2 or 3 teeth separated by at least 1 very deep incision (Figs. 90, 402, 412). [Mesoscutum slightly depressed.] .... some Miscogastrini, 77

– Clypeal margin symmetric, either truncate or with 1–3 teeth or lobes (Figs. 438, 440, 441, 442, 467), the deepest separation usually broader than deep .... mainly PTEROMALINAE, 125

125(124) Petiole conspicuous (at least in posterodorsal view), often parallel-sided and dorsally with distinct reticulation or rugae (Figs. 432, 434, 436) or, if rarely smooth, petiole at least twice as long as broad 126

– Petiole not conspicuous, usually subtriangular **or**, if exposed (usually concealed under distinct propodeal nucha), more or less smooth and slightly oblong (as in Fig. 480) 149

126(125) Petiole bordered on either side by flange, the flange formed by extension of Gs_1 and usually slightly shorter than petiole (Figs. 162, 166, 432) 127

– Petiole appearing simple, Gs$_1$ not extending far forward beneath petiole [petiole sometimes similar in appearance to above because either anterior corners set off by short groove or, rarely, lateral parts of petiole separated off by longitudinal sulci (Fig. 434)] 133

127(126) Mesopleuron with entire mesepimeron reticulate (Fig. 433) 128

– Mesopleuron with upper mesepimeron smooth (as in Fig. 435) 129

128(127) Marginal vein approximately same thickness along entire length (Fig. 156); gaster with Gt$_1$ and Gt$_2$ approximately equal in length, in air-dried specimens together covering most of gaster (Fig. 156) .... ***Pachycrepoideus*** Ashmead (part)

Fauna: 1 cosmopolitan sp., *P. vindemmiae* (Rondani). **Hosts**: small Diptera, particularly Drosophilidae.

– Marginal vein thicker basally than apically (Fig. 165); gaster with Gt$_1$ much longer than Gt$_2$, together covering less than half of gaster (Fig. 165) .... ***Babina*** Bouček

Fauna: 1 sp., *B. gracilis* Bouček (1993*b*), in Canada (NF).

129(127) Clava acuminate (Fig. 159) or tapering into distinct terminal spine (Fig. 157); flagellum with 3 anelli and 5 funicular segments; face with lower margin often notched lateral to clypeus so anterior margin of clypeus either truncate or roundly produced; pronotal collar with sharp margin; propodeum usually with long, convex, reticulate nucha; Gt$_1$ often covering most of gaster. [Male of *C. hilla* Bouček (1993*b*) with marginal vein strongly broadened (Fig. 160).] .... ***Callitula*** Spinola (part)

Fauna: at least 7 spp. **Hosts**: Diptera, e.g., *Mayetiola* (Cecidomyiidae) and leaf-mining Agromyzidae.

– Clava blunt apically; flagellum with 2 or 3 anelli; face with lower margin more or less straight; pronotal collar margined or not; propodeum often without globose reticulate nucha; Gt$_1$ not covering most of gaster 130

130(129) Marginal vein distinctly broadened, widening toward apex (Figs. 207–209), rarely almost parallel-sided; clypeal margin often medially produced; propodeum tapered into subglobose neck, the neck more or less reticulate; Gt_1 with posterior margin roundly produced and Gt_2 short .... ***Pachyneuron*** Walker, see 165

– Marginal vein not broadened (Figs. 168–170); clypeal margin rarely produced; propodeum and anterior gastral terga also mostly different 131

131(130) Propodeum strongly reticulate, without carinae (Fig. 164); pronotal collar margined with sharp carina; mesoscutum posteriorly with black bristles; flagellum with third anellus often larger than basal 2 anelli combined (Fig. 163) .... ***Vrestovia*** Bouček

Fauna: 1 sp., *V. brevior* Bouček (1993*b*), in Canada (BC, PQ) and USA (MI, PA, VA).

– Propodeum anteriorly with 2 large transverse areolae delimited by angular carinae (Fig. 485); pronotal collar without sharp carina (Fig. 161); mesoscutum with white setae; flagellum with third anellus not larger than basal 2 anelli combined 132

132(131) Gena with large depression at mouth corner (Fig. 161); mouth margin not straight, clypeal margin delimited by indentation and with 2 broad teeth; Gs_1 with anteriorly produced flange about as long as breadth of petiole and with anterior margin of flange not turned ventrally; metatibia with 1 spur .... ***Propodeia*** Bouček (part)

Fauna: 1 sp., *P. complexa* Bouček (1993*b*), in USA (FL, VA).

– Gena convex, without depression at mouth corner; mouth margin, in particular clypeal margin, straight; Gs_1 with anteriorly produced flange short and with anterior margin of flange strongly turned ventrally, reaching apex of propodeal nucha; metatibia often with 2 spurs .... ***Heteroschema*** Gahan, see 290

133(126) Mesosoma very high and robust; procoxa separated from mesocoxa by horizontal shelf delimited by transverse carina posterior to procoxae (Fig. 170); pronotum as broad as mesoscutum, vertical anteriorly and dorsally with crested edge; scutellum with frenal groove; petiole at least as long as steep propodeum; gena posteriorly with strong carina .... ***Paracarotomus*** Ashmead

Fauna: 1 sp., *P. cephalotes* Ashmead, in Canada (BC) and USA (MD, VA). **Hosts**: pupae of some aphid-feeding Syrphidae.

– Mesosoma not unusually high, without horizontal shelf delimited by carina; pronotum in most species different; scutellum with frenum only rarely distinct; petiole shorter or gena not carinate 134

134(133) Propodeum with nucha very long, narrow, and constricted before apex; petiole long, in lateral view sinuate (Fig. 168). *Female*: flagellum with 3 anelli. *Male*: flagellum with 2 anelli .... ***Miristhma*** Bouček

Fauna: 1 sp., *M. peckorum* Bouček (1993*b*), in USA (FL) [additional spp. in Neotropical region].

– Propodeum without nucha or at most with short and non-constricted nucha (Fig. 436); petiole in most species different. *Female*: flagellum usually with 2 anelli (3 in *Toxeumelloides*). *Male*: where known, with 2 anelli 135

135(134) Forewing unusually long and narrow, about 3 times as long as broad, with marginal vein at least 3 times as long as stigmal vein (Fig. 169); petiole subquadrate, broadening posteriorly, with irregular longitudinal rugosity (Fig. 436); toruli very high on strongly convex, shiny face, the sculpture below toruli very weak (Fig. 437); clypeus as high as broad. [Appendages very slender and mostly yellow.] .... PANSTENONINAE, ***Panstenon*** Walker

Fauna: 1 widespread sp., *P. poaphilum* Heydon. **Hosts**: predator of eggs and larvae in grass stems. (See Heydon and Bouček 1992.)

– Forewing broader, with marginal vein usually shorter; petiole often longer, in most species not broadening posteriorly; toruli usually lower on face, the face less convex and mostly reticulate; clypeus transverse 136

136(135) Gt_1 with posterior margin broadly emarginate and Gt_2 large (Fig. 171); petiole transverse but with coarse longitudinal ridges; propodeum coarsely rugoso-alveolate; clypeal margin with 3 teeth (Fig. 425) .... ***Cyrtogaster*** Walker, see 116

– Gt_1 and Gt_2 usually different or, if Gt_1 broadly emarginate and Gt_2 large (some *Sphegigaster*), petiole long and propodeum densely reticulate; other characters in part different 137

137(136) Petiole subquadrate and virtually smooth (as in Fig. 480) 138

– Petiole transverse to distinctly elongate, if subquadrate then dorsally either reticulate or with transversely rugulose or pentagonal sculpture 139

138(137) Clypeal margin with median tooth (Fig. 467); body slender, with mesosoma at least 1.8 times as long as broad .... ***Stenomalina*** Ghesquière, see 225

– Clypeal margin without median tooth, broadly truncate or shallowly wavy (Fig. 226); mesosoma short .... ***Kaleva*** Graham, see 182

139(137) Clypeal margin with median tooth and in most species with a smaller tooth on each side (more or less 3-toothed) (Fig. 174) 140

– Clypeal margin bidentate, or medially emarginate, or slightly produced in arch 142

140(139) Metacoxa dorsally setose (Fig. 172); gaster dorsally convex, even in air-dried specimens, and Gt_1 with posterior margin straight; propodeum broadly convex, and with coarsely raised reticulate sculpture and some rugae between plicae (Fig. 428); face with small but distinct tentorial pits (Fig. 429) .... ***Bubekia*** Dalla Torre (part)

Fauna: about 4 spp. in southern USA [genus speciose in Neotropical region]. **Hosts**: Diptera, especially those associated with grasses.

– Metacoxa dorsally bare; gaster flat or dorsally depressed in air-dried specimens, and Gt_1 with posterior margin sinuate laterally and usually emarginate medially; propodeum only slightly arched along median carina and smooth or weakly reticulate between plicae; face with shallow and inconspicuous tentorial pits 141

141(140) Pronotum large, with collar less than 4 times as broad as median length, and with rectangular shoulders (Fig. 173); clypeal margin symmetrical with broad median tooth and smaller tooth on each side (Fig. 174); mesosoma usually evidently flattened. *Female*: hypopygium extending almost to apex of gaster .... ***Syntomopus*** Walker

Fauna: 2 spp., *S. americanus* Ashmead and *S. arpedes* Heydon. **Hosts**: Agromyzidae boring in plant stems, e.g., *Cirsium*, *Carduus*. (See Heydon 1993.)

– Pronotum shorter, with collar more than 5 times as broad as median length, and with shoulders more rounded; clypeal margin in most species asymmetric, either with 1 narrow tooth (Fig. 403) or with 3 sharp teeth (Fig. 402); mesosoma at least slightly convex dorsally. *Female*: hypopygium extending at most two-thirds length of gaster .... ***Thinodytes*** Graham, see 80

142(139) Postmarginal vein only as long as stigmal vein, and each vein hardly one-third as long as marginal vein (Fig. 178); forewing without marginal setae; head with upper face broader than length of flagellum plus pedicel combined; genae strongly converging ventrally (Fig. 179) and flattened at mouth corner .... ***Yosemitea*** Bouček

Fauna: 1 sp., *Y. latifrons* Bouček (1993*b*), in USA (CA). **Hosts**: unknown, but collected on *Pinus*.

– Postmarginal vein distinctly longer than stigmal vein, and each vein longer relative to marginal vein; forewing with marginal setae; head with upper face narrower and gena different, sometimes with depression at mouth corner 143

143(142) Clypeal margin with 2 sharp teeth (Figs. 177, 438); propodeum convex 144

– Clypeal margin different, either with 2 short rounded teeth, or shallowly emarginate to truncate, or arched, or with broad median projection; propodeum not regularly convex 145

144(143) Propodeum with median carina, plicae, and shiny submedian areas (Fig. 409), in most species with sculpture weaker than on scutellum, but in some species coarsely rugose; petiole at most 1.5 times as long as broad; Gt [illegible] with posterior margin almost straight but with small incisi[illegible] medially; Gt_2 short; pronotum with collar anteriorly round[illegible] .... ***Halticoptera*** Spinola, see 81

– Propodeum without longitudinal carinae, about as strongly reticulate as scutellum, dull (Fig. 439); petiole longer (Fig. 175); Gt_1 with posterior margin subtruncate or slightly arched medially, but with sides produced posteriorly; Gt_2 very large (Figs. 175, 176); pronotum sometimes with several teeth on anterior margin of collar .... ***Sphegigaster*** Spinola

Key: Heydon and LaBerge (1988). **Fauna**: at least 8 spp. **Hosts**: Agromyzidae boring in plants stems. (See also Heydon and Bouček 1992.)

145(143) Propodeum without costula, hence without transverse areolae, but with irregular plicae subparallel in anterior half (Fig. 189); gaster with most of surface covered by anterior 2 terga .... ***Polstonia*** Heydon (part)

Key: Heydon (1988*a*). **Fauna**: 2 spp. [several species in Neotropical region]. **Hosts**: probably Diptera.

– Propodeum with at least blunt transverse costula delimiting 2 large anterior areolae separated by median carina (Fig. 185), the areolae laterally delimited by curved plicae; gaster different 146

146(145) Torulus above middle of eye, in dorsal quarter of face (Figs. 180, 181); scape far exceeding vertex; gena swollen; petiole distinctly sculptured, only slightly longer than broad and anteriorly with tooth-like corners; propodeal nucha produced beyond supracoxal flange; flagellum filiform. *Male*: lower face with 2 or 4 tooth-like projections lateral to clypeus (Fig. 181). [*Male*: flagellum with 2 anelli. *Female*: flagellum with 3 anelli.] .... ***Alticornis*** Bouček (part)

Fauna: 1 sp., *A. dracula* Bouček (1993*b*), in USA (FL) [3 more species in Mexico and Caribbean countries].

– Torulus at most slightly above middle of face (Fig. 182); scape usually not exceeding vertex; gena not swollen; petiole different; nucha and flagellum often different. *Male*: lower face without projections 147

147(146) Petiole more than twice as long as broad, at least partly shiny, and tapering posteriorly (Fig. 185); gena with depression at mouth corner. *Female*: flagellum filiform (Fig. 184) or subclavate. *Male*: flagellum distinctly setose. [Stigmal vein not capitate (Fig. 186).] .... ***Toxeumelloides*** Girault

Fauna: at least 4 spp. [more in Neotropical region]. (See Bouček 1993*b*.)

– Petiole only slightly longer than broad and dorsally more or less reticulate; gena sometimes without distinct depression at mouth corner; flagellum often different 148

148(147) *Male* (female unknown): flagellum rather fusiform and compact; flagellar segments virtually bare but each segment with 1 row of dense, strong longitudinal sensilla (Fig. 182); forewing with stigma rather capitate (Fig. 183) .... ***Bonitoa*** Bouček

Fauna: 1 sp., *B. nigra* Bouček (1993*b*), in USA (AZ).

– *Male*: flagellum of almost same breadth; flagellar segments well separated and usually on conspicuous peduncles, each segment having dense setae, with each seta arising on a tubercle and either erect or decumbent (Figs. 296, 345, 346); forewing with stigma hardly capitate .... ***Psilocera*** Walker, see 281

149(125) Mesonotum with notauli extremely deep and almost complete (Fig. 128) and with scutoscutellar sutures very deep, hence mesoscutal lobes and scutellum very high .... ***Arriva*** Bouček, see 108

– Mesonotum with notauli shallow, indistinct beyond middle of mesoscutum, and with scutoscutellar sutures not unusually deep .... most PTEROMALINAE, 150

150(149) Antenna apparently 12-segmented (Fig. 187); torulus distinctly below middle of face; postmarginal vein hardly longer than stigmal vein (Fig. 188), the stigmal vein with distinct uncus; marginal vein slightly thickened and slightly shorter than stigmal vein. *Female*: flagellum clavate, with segments increasing in size to first claval segment, and with basal 2 segments anelliform. [Body squat, less than 1.5 mm long.] .... ***Amphidocius*** Dzhanokmen

Fauna: 1 described sp., *A. schickae* Heydon & Bouček (1992), in Canada (BC) and western USA, and several undescribed spp. **Hosts**: in galls of *Neuroterus saltatorius* (Edwards) (Cynipidae) on *Quercus*.

– Antenna 13-segmented; other characters different 151

151(150) Mesosoma very high (Fig. 190), procoxa separated from mesocoxa by horizontal shelf, the shelf delimited by transverse ridge posterior to procoxae; gaster in most species small relative to mesosoma 152

– Mesosoma not unusually high, without horizontal shelf delimited by carina, hence procoxa close to mesocoxa; gaster only rarely much smaller than mesosoma 154

152(151) Thorax with pronotum, mesoscutum, and scutellum having strong, dense, umbilicate punctures, each puncture having a seta; eye with conspicuous setae. *Both sexes*: flagellum with 2 short anelli and 6 funicular segments (Fig. 190) .... ***Perilampidea*** Crawford

Fauna/Hosts: at least 1 sp. possible in southern Nearctic region [in Neotropical region at least 2 spp., including Caribbean *P. syrphi* Crawford, in pupae of Syrphidae].

– Thorax with dorsum, at least in greater part, reticulate, but not every dot having a seta; eye almost or entirely bare. *Female*: flagellum with 2 or 3 anelli 153

153(152) Gena flat or convex at mouth corner; pronotum subcarinate or irregularly carinate and with vertical neck sculptured; thoracic dorsum often with some umbilicate punctures; scutellum with distinct frenal groove (Fig. 191); forewing extensively setose on upper surface .... ***Halticopteroides*** Girault

Fauna/Hosts: 2 spp., *H. exemae* Bouček in USA (FL) on *Exema* (Chrysomelidae), and 1 undescribed sp. in Canada (ON) [several spp. in Neotropical region]. (See Bouček 1993*b*.)

– Gena with large depression at mouth corner (Fig. 192); pronotum with collar margined with high smooth carina (Fig. 194), and with vertical neck smooth; thoracic dorsum with regular, dense, raised-reticulate sculpture; scutellum with frenal groove completely obliterated; forewing bare basal to stigmal vein, but on lower surface with 2 rows of admarginal setae (Fig. 193) .... ***Jaliscoa*** Bouček

Fauna: 1 sp., *J. nudipennis* Bouček (1993*b*), in Mexico (Jalisco).

154(41, 55, 151) Marginal vein broadened throughout or at least in basal half (Figs. 195, 199, 202) 155

– Marginal vein not or hardly broadened 166

155(154) Marginal vein at least slightly tapering in apical half (Figs. 195, 197, 202) 156

– Marginal vein either equally broadened throughout (Fig. 200) or wedge-like, broadening apically (Figs. 207–209) 159

156(155) Marginal vein at most as long as stigmal vein, the stigmal vein with distinct knob (Fig. 195); face regularly convex, without scrobes, and with torulus well above lower margin of eye; thorax short and convex, hardly 1.1 times as long as broad; pronotum almost as broad as mesoscutum and dorsally rounded; Gt_1 with posteromedial margin obtuse-angularly excised; mesotibia with 2 spurs; metacoxa dorsally setose; clypeus reticulate, with apical margin having 2 rounded lobes separated by median incision .... ***Caenocrepis*** Thomson

Fauna: 1 Holarctic sp., *C. arenicola* (Thomson), in USA (MT, TX). **Hosts**: unknown, but extralimital spp. in eggs of Curculionidae on herbaceous plants in arid areas.

– Marginal vein distinctly longer than stigmal vein; other characters at least in part different 157

157(156) *Male only*: marginal vein sausage-like, broadest in middle (Fig. 197); legs beyond coxae pale yellow; flagellum brownish; forewing hyaline .... ***Mesopolobus*** Westwood, see 306

Note: only *M. morys* (Walker), introduced into northwestern USA to control *Ceutorhynchus* (Curculionidae) on *Brassica*.

– *Both sexes*: marginal vein parallel-sided or otherwise different; legs or flagellum with color different; forewing often with maculae 158

158(157) Postmarginal vein at most 1.1 times as long as stigmal vein; head often either protuberant at level of toruli or, more ventrally, produced into beak; clypeus with apical margin truncate or emarginate 185

– Postmarginal vein much longer than stigmal vein; head neither protuberant at level of toruli nor with beak; clypeus smooth and apically with conspicuous median tooth (Fig. 279). [Marginal vein very slightly thickened, the thickening hardly noticeable (Fig. 277).] .... ***Hemitrichus*** Thomson, see 226

159(155) *Female*: flagellum unusual, short and clavate, the clava with apical segment a narrow digit-like process (Fig. 198). *Male*: flagellum almost filiform, clava not modified. *Both sexes*: forewing with marginal vein thick, stigmal vein capitate, both veins distinctly darkened, and wing often with dark rectangular macula adjacent to marginal vein (Fig. 199) .... ***Rhaphitelus*** Walker

Fauna: 1 Holarctic sp., *R. maculatus* Walker. **Hosts**: Scolytidae (mainly *Scolytus*) and Curculionidae (e.g., *Magdalis*, *Pissodes*) in twigs of trees.

– *Female*: flagellum different, apical segment of clava not digitiform. *Both sexes*: forewing with stigmal vein not or hardly capitate and maculae, if present, different 160

160(159) Metacoxa distinctly setose anterodorsally (as in Figs. 455, 457); forewing with brown macula, in most species attached to marginal vein; pronotum subconical, dorsally rounded, without distinct transverse margin 161

– Metacoxa dorsally bare; forewing hyaline or with diffused infumation; pronotal collar usually delimited by distinct margin 162

161(160) Postmarginal vein shorter than stigmal vein; marginal vein less than 4 times as long as broad (Fig. 200); prepectus with at least 1 short row of fine setae near posterior margin .... ***Metacolus*** Förster

Key: Burks (1965). **Fauna**: at least 2 spp., including the common *M. fasciatus* Girault. **Hosts**: Scolytidae in twigs of conifers, especially of *Pinus*.

– Postmarginal vein longer than stigmal vein (Fig. 201); marginal vein at least 5 times as long as broad; prepectus bare .... ***Rhopalicus*** Förster, see 214

162(160) Clava with apex acute or acuminate (Figs. 272, 273); forewing with fuscous infumation behind marginal vein (Fig. 202). *Male*: petiole conspicuous in some species .... ***Homoporus*** Thomson, see 223

– Clava with apex not acuminate; forewing not infumate. *Both sexes*: petiole inconspicuous 163

163(162) Mesopleuron completely reticulate (Fig. 433); torulus at lower margin of eye; pronotal collar not margined (Fig. 156); petiole, if exposed, reticulate and bordered on either side by flange formed by extension of Gs_1 (Fig. 432) .... ***Pachycrepoideus*** Ashmead, see 128

– Mesopleuron with upper mesepimeron shiny (below base of hind wing); torulus at least slightly above lower margin of eye; pronotal collar margined, except in some *Pachyneuron*; petiole sometimes longer than broad and different from above 164

164(163) Torulus slightly above middle of face and flagellum with 3 very short anelli; flagellum with dense and conspicuous longitudinal sensilla, the sensilla long and very regular (Fig. 205); marginal vein parallel-sided, only moderately broadened (Fig. 204); propodeum strongly reticulate, tapering to nucha. [Body as in Fig. 203.] .... ***Metastenus*** Walker

Fauna/Hosts: probably 2 spp., including *M. townsendi* (Ashmead), on Coccinellidae, especially those feeding on Coccoidea.

– Torulus usually below middle of face or, if slightly above, flagellum with 2 not unusually short anelli [except 3 anelli in female *Pachyneuron aphidis* (Bouché)]; flagellum with longitudinal sensilla not very long or regular; marginal vein more or less broadening apically; propodeum at most finely reticulate, often not tapering to nucha 165

165(164) Gaster dorsally rather strongly convex; torulus slightly above middle of face; face almost entirely vertically striate or at least reticulations with strong vertical component; petiole transverse (Fig. 212), dorsally with weak to strong median longitudinal carina .... ***Euneura*** Walker

Fauna: About 3 spp., mainly *E. lachni* (Ashmead). **Hosts**: hyperparasites of Aphididae.

– Gaster dorsally at most weakly convex (dorsal surface more or less concave or flat in air-dried specimens); torulus below middle of face; face reticulate centrally, not striate; petiole of variable length, transverse to elongate (Fig. 167), dorsally smooth or transversely reticulate or striate. [Marginal vein variable, as in Figs. 207–209; *P. aphidis* with 3 anelli in female antenna (Fig. 206), parasite of aphids; *P. mucronatum* Girault (Fig. 208) and *P. eros* Girault with pronotum dorsally rounded and clypeal margin with median tooth, may be separated in subgenus *Nepachyneuron* Girault 1917.] .... ***Pachyneuron*** Walker (part)

Fauna: at least 12 spp. **Hosts**: mostly associated with Coccoidea, Aphidoidea, and their predators, rarely in eggs of Lepidoptera on conifers.

166(154) Flagellum with 7 or 8 large segments between pedicel and clava, the basal segments subquadrate or quadrate (Fig. 210) and smaller than middle segments but not quite anelliform 167

– Flagellum with the basal 2 or 3 segments (rarely more) distinctly anelliform 171

167(166) Head massive, upper face with 2 pairs of oblique projections (Figs. 210, 440); temple in dorsal view about as long as eye; clypeus with strong radiating striae; forewing extensively setose, with speculum only slightly indicated; venation as in Fig. 211; petiole subquadrate; flagellum with first segment slightly longer than second .... ***Cratomus*** Dalman

Fauna: 1 Holarctic sp., *C. megacephalus* (Fabricius). **Hosts**: *Agrilus* (Buprestidae), and small Sphecidae nesting in stems or holes in dead wood.

– Head without facial projections; temple in dorsal view shorter than eye; other characters different 168

168(167) Propodeum with distinct, subglobose, reticulate nucha usually concealing a slightly elongate petiole (Fig. 213) 169

– Propodeum without distinctly globose nucha; gaster sessile 170

169(168) Head without occipital carina; gena with small depression at mouth corner; Gt_2 greatly enlarged (Fig. 213); metacoxa dorsally with abundant setae; forewing with basal third bare and with large speculum .... ***Dineuticida*** Bouček

Fauna: 1 sp., *D. dineutis* (Ashmead). **Hosts**: cocoons of *Dineutes* (Gyrinidae). (See Bouček 1993*b*.)

– Head with distinct occipital carina; gena with extensive depression at mouth corner; Gt_2 not unusually large; metacoxa dorsally bare; forewing with basal cell bare but without speculum .... ***Sisyridivora*** Gahan

Fauna: 1 sp., *S. cavigena* Gahan, in USA (CA, CT, MT, OH, PA). **Hosts**: cocoons of Sisyridae.

170(168) Postmarginal vein not or hardly longer than stigmal vein; head more or less stout, with toruli on protuberance at lower margin of eye (Figs. 214, 448); flagellum with first 2 segments subquadrate (Fig. 239) 196

– Postmarginal vein distinctly longer than stigmal vein; head not protuberant at level of toruli; flagellum with first 2 segments usually anelliform 249

171(166) Head massive, in dorsal view less than twice as broad as long and eye almost as long as temple (Fig. 214); scrobes rather deep, with abruptly ending interantennal crest; distance between posterior ocelli slightly less than distance from ocellus to eye; marginal vein twice as long as stigmal vein (Fig. 215) .... ***Xiphydriophagus*** Ferrière

Fauna: 1 Holarctic sp., *X. meyerinckii* (Ratzeburg). **Hosts**: *Xiphydria* (Xiphydriidae) in branches of deciduous trees.

– Head less massive, with eye relatively much larger and with temple shorter or, if similar to above (*Gbelcia*, Fig. 293), then scrobes without interantennal crest; posterior ocelli in most species not so close to each other; marginal vein usually shorter than stigmal vein 172

172(171) *Female*: gaster with ovipositor sheaths greatly protruding (Fig. 216), with last tergum short, and with elongate cerci. *Both sexes*: lower face with conspicuous, deep, hole-like, scattered punctures (Fig. 441); pronotum dorsally not margined .... ***Roptrocerus*** Ratzeburg

Fauna: 1 Holarctic sp., *R. xylophagorum* (Ratzeburg). **Hosts**: Scolytidae on conifers.

– *Female*: gaster with ovipositor sheaths at most slightly protruding or, if as narrow tail, most of sheaths covered by long last tergum (*Eulonchetron* and some *Holcaeus*, see couplet 250; and *Anogmus*, see couplet 308). *Both sexes*: lower face without deep, hole-like punctures; pronotum in most species with transverse margin or carina 173

173(172) Forewing with large dark infumation (Figs. 217, 218) **and** clypeus reticulate and with median tooth on margin (Fig. 442); pronotum without transverse margin (Fig. 443); torulus at lower margin of eye; notauli often traceable posteriorly; head in anterior view appearing distinctly wider than high .... ***Brachycaudonia*** Ashmead

Fauna: At least 3 spp., including *B. californica* Ashmead in USA (CA) and *B. cyaniceps* Bouček in Canada (ON) and USA (VA). **Hosts**: probably Scolytidae. (See Bouček 1993*b*.)

– Forewing without such infumation **or**, if clypeal margin with median tooth, clypeus not reticulate **or** pronotum with margin delimiting collar; torulus often above lower margin of eye; notauli usually not traceable posteriorly; head in most species appearing about as wide as high 174

174(173) Profemur and metafemur distinctly enlarged (Fig. 219), the profemur with obtuse-angular expansion; pronotum medially very short but in lateral view longer than mesopleuron; forewing often with 2 dark bands; metatibia dorsally with short spines .... ***Cheiropachus*** Westwood

Key: Gahan (1938). **Fauna/Hosts**: 4 described spp. [some may be forms of *C. quadrum* (Fabricius), a Holarctic parasite of various wood-boring Coleoptera, especially Scolytidae].

– Profemur and metafemur not conspicuously enlarged **or** profemur, pronotum, and forewing different; metatibia dorsally without distinct spines 175

175(174) Body with extremely dense and conspicuous reticulation, including outer panel of axilla (facing wing base) (Figs. 444, 445); body with strong metallic colors and forewing usually with infumation at veins. [Pronotal carina present or absent.] .... ***Boharticus*** Grissell

Key: Grissell (1983). **Fauna**: at least 6 spp. in USA. **Hosts**: associated with *Juniperus*.

– Body with at least outer panel of axilla striate or smooth (Figs. 447, 449) and other body parts not so extremely densely reticulate; specimen only rarely with both metallic colors and infumations at veins 176

176(175) Head with distinct, narrow but high ridge between toruli; scrobes narrow and deep; clypeal margin bilobed; propodeum with transverse costula. *Female*: Gt_1 with posterior margin deeply, broadly emarginate (Fig. 124). *Male*: Gt_1 with posterior margin shallowly emarginate. [Stigmal vein capitate (Fig. 123).] .... ***Ficicola*** Heydon, see 105

– Head without ridge between toruli or, if with low ridge (*Habritys*), clypeal margin almost straight; propodeum without costula; Gt_1 without emargination 177

177(176) Face with strong striation radiating from mouth margin and extending above toruli (Fig. 446); scutellum unusually convex (Figs. 220, 447), narrowing anteriorly, and dorsally densely setose (as is mesoscutum); antenna short, the flagellum usually with 2 anelli and with subquadrate funicular segments or all segments more or less transverse. *Female*: gaster not longer than mesosoma .... ***Epipteromalus*** Ashmead

Fauna/Hosts: At least 4 spp.; the only described sp., the widespread *E. algonquinensis* Ashmead, associated with spider (Araneae) egg-sacs; another sp. reared from Coleophoridae.

– Face not extensively striate or, if so, scutellum not unusually convex or not setose along middle; antenna usually different and/or female gaster longer 178

178(177) Head (including lower face), thoracic dorsum, and forewing with very dense setae (Fig. 221); eye setose 179

– Head, thoracic dorsum, and forewing in basal third at least partly without such dense setae; eye mostly bare or sparsely setose 180

179(178) Flagellum shorter than breadth of upper face, with all segments transverse, the basal segments more or less anelliform; clypeal margin produced as 2 semicircular, thin lobes (Fig. 222) .... ***Grissellium*** Bouček

Fauna: 1 sp., *G. hirtulum* Bouček (1993*b*), in Canada (ON) and USA (eastern states and TX).

– Flagellum longer than breadth of upper face, with 2 anelli and 6 subquadrate funicular segments; clypeal margin different 192

180(178) Flagellum much shorter than breadth of upper face, either with 3 anelli and 5 transverse funicular segments (Fig. 223) or number of anelli difficult to determine because all segments before clava strongly transverse (Fig. 226); gaster usually as long as mesosoma or shorter. [Mesosoma not extremely flat.] 181

– Flagellum at least as long as breadth of upper face **or** with only 2 anelli and 6 funicular segments; gaster often longer than mesosoma 183

181(180) Head in dorsal view with temple conspicuous, partly swollen and at least half as long as eye (Fig. 223); metatibia with 2 spurs; clypeus unusually large, either flat (Fig. 224) or dorsal half strongly swollen, and with apical margin almost straight .... ***Habritys*** Thomson

Fauna/Hosts: 2 spp., the Holarctic *H. brevicornis* (Ratzeburg) on Crabroninae (Sphecidae) in rotten wood, and *H. latrus* Wallace.

– Head in dorsal view with temple less than half as long as eye, either much shorter than above or strongly converging; metatibia in most species with 1 spur; clypeus different 182

182(181) Gaster on subquadrate petiole; pronotum margined or not. *Female*: gaster subcircular (Fig. 225), with very small, flat hypopygium .... ***Kaleva*** Graham (part)

Fauna/Hosts: 2 spp., including *K. microps* Bouček, probably on small wasps [in Europe on *Spilomena* (Sphecidae: Pemphredoninae)] nesting in holes made by Anobiidae in dead wood. (See Bouček 1993*b*.)

– Gaster sessile; pronotum dorsally rounded. *Female*: gaster distinctly elongate (Fig. 339) and with hypopygium reaching or almost reaching its apex 278

183(180) Notauli, at least in certain lights, traceable to posterior margin of mesoscutum, although posteriorly very shallow; torulus at or close to lower margin of eye; flagellum with 2 or 3 anelli 99

– Notauli not completely traceable to posterior margin of mesoscutum **or**, in doubtful cases, torulus often higher on face and flagellum with long funicular segments following 3 short anelli 184

184(66, 183) Postmarginal vein at most 1.1 times as long as stigmal vein (Figs. 227, 229, 231, 233, 234, 251); forewing of most species with anteroapical margin not having distinct fringe of setae; torulus distinctly below middle of face, often even below lower margin of eye 185

– Postmarginal vein distinctly longer than stigmal vein (except *Acaenacis*, see couplet 277 and Fig. 337); forewing margin with distinct fringe of setae, even along anteroapical margin; torulus usually higher (very high in *Acaenacis*, see Fig. 481) 204

185(158, 184) Marginal vein distinctly thickened basally (Figs. 227, 229) 186

– Marginal vein not thickened or only slightly broader basally than apically 187

186(185) *Female* (male unknown): lower face medially with strong nose-like projection (Fig. 230) above clypeus; clypeal margin with small median tubercle; mandible modified, basally with short depression before high transverse ridge and flat beyond ridge; flagellum with second anellus only slightly transverse (Fig. 230) and half length of third (= first funicular) segment [first funicular segment oblong] .... ***Helocasis*** Wallace

Fauna: 1 sp., *H. burksi* Wallace, in eastern USA.

– *Both sexes*: lower face without projection but protuberant at toruli (Fig. 448); clypeal margin subtruncate; mandible normal, slightly curved. *Female*: flagellum with second segment quadrate and only slightly shorter than third segment (Fig. 228*a*). *Male*: flagellum filiform, with 2 strongly transverse anelli and very long third segment (Fig. 228*b*) .... ***Muscidifurax*** Girault & Sanders

Fauna: several spp. separated primarily on biological differences; mainly *M. raptor* Girault & Sanders. **Hosts**: fly puparia, including *Musca* and *Stomoxys* (Muscidae). (See Kogan and Legner 1970.)

187(185) *Female* (male unknown): scutellum subconically produced over propodeum (Fig. 231); forewing with parastigma having 3 long bristles and with stigma distinctly capitate; gena with slight depression at mouth corner; flagellum strongly clavate .... ***Meximalus*** Bouček

Fauna: 1 sp., *M. heratyi* Bouček (1993*b*), in Mexico (Guerrero).

– *Both sexes*: scutellum not produced; forewing without unusual bristles on parastigma and stigma at most slightly capitate; other characters in part different 188

188(187) Femora and tibiae, particularly metafemur and metatibia, broadened and compressed, the metatibia less than 5 times as long as broad (Fig. 232) and with 2 apical spurs; marginal vein as long as postmarginal vein and hardly longer than stigmal vein (Fig. 233) .... ***Ptinocida*** Bouček

Fauna: 1 sp., *P. latipes* Bouček (1993*b*), in USA (CA). **Hosts**: cocoons of *Ptinus californicus* Pic (Ptinidae).

– Femora and tibiae not conspicuously broadened, the metatibia with 1 apical spur; marginal vein longer than either postmarginal or stigmal veins 189

189(188) Forewing with stigma having unusually long uncus (Fig. 81); axillae considerably advanced (Fig. 401); lower face reticulate; clypeal margin with notch at each lateral corner so median part distinctly truncate; pronotum with lateral panel flat .... ***Hemadas*** Crawford, see 68

– Forewing with stigma having at most short uncus (Figs. 234, 249); axillae not advanced; lower face with vertical striation, at least at sides of clypeus; clypeal margin usually emarginate; pronotum with lateral panel having diagonal depression for reception of foreleg when folded against body 190

190(189) Head and mesosoma unusually shiny, with very superficial reticulation; occiput with fine horseshoe-like carina near occipital foramen (Fig. 251) .... ***Duartea*** Bouček, see 205

– Head and mesosoma distinctly reticulate and not very shiny; occiput either without carina or with carina almost horizontal medially 191

191(190) Scutellum with distinct frenal groove (at least if illuminated from in front, Figs. 234, 449) and posteriorly strongly convex. [Gena with distinct depression; gaster circular to short-ovate; wing bare medially.] .... ***Schizonotus*** Ratzeburg

Fauna: At least 1 sp., *S. sieboldi* (Ratzeburg). **Hosts**: larvae of Chrysomelidae, in particular *Chrysomela* and *Plagiodera*.

– Scutellum without distinct frenal groove or, if detectable, groove very shallow or indicated only by change of sculpture, and scutellum posteriorly only slightly convex 192

192(179,191) Eye with conspicuous setae; forewing with marginal setae; propodeum posteriorly with strong rugae. *Female*: flagellum clavate (Fig. 237), the clava with micropilose area on apical 2 or 3 segments; gaster circular to ovate. *Male*: antenna stout and yellowish; gena swollen; mouth unusually broad (Fig. 236) ....***Diglochis*** Förster (part)

Fauna: At least 3 spp. **Hosts**: pupae of Tabanidae in damp ground and in forests.

– Eye at most with some sparse and very short, inconspicuous setae; forewing with marginal setae strongly reduced on anteroapical margin; propodeum usually without coarse alveolation. *Female*: flagellum at most slightly clavate, the clava without micropilose areas. *Male*: antenna slender and not yellow; genae not swollen, converging; mouth not very broad 193

193(192) Occiput with distinct arch-like margin (Figs. 377, 450) near posterior margin of vertex [*D.* (*Dibrachys*)] or near occipital foramen [*D.* (*Allodibrachys*) *hians* Bouček, as in Fig. 251]. [Body, see Fig. 377.] ....***Dibrachys*** Förster (part)

Key: Grissell (1974). **Fauna/Hosts**: at least 8 spp.: mostly hyperparasites in cocoons and pupae of Lepidoptera through Tachinidae (mostly), Braconidae, or Ichneumonidae; *D. hians* in nests of *Vespula* (Vespidae) in USA (VA).

– Occiput not distinctly margined but, if head massive, vertex usually with distinct though blunt posterior margin, the margin rarely right-angled in lateral view (*Dibrachoides*, see couplet 195)............................ 194

194(193) Propodeum with conspicuously reticulate, globose nucha (Figs. 372, 451) .... ***Nasonia*** Ashmead, see 207

– Propodeum at most with short nucha and then nucha not distinctly reticulate and globose 195

195(194) Vertex unusually flat, almost horizontal posterior to eyes and ocelli, and right-angled into occiput (Fig. 235); face not protuberant at level of toruli; propodeum with median area hardly twice as broad as long. [Forewing centrally almost bare.] .... ***Dibrachoides*** Förster

Fauna/Hosts: 1 sp., *D. dynastes* (Förster), introduced from Europe to control *Hypera* (Curculionidae), especially on alfalfa.

– Vertex posteriorly at least slightly convex; face more or less protuberant at level of toruli, and below toruli often strongly receding towards mouth; propodeum with median area often broader 196

196(170, 195) Gena with distinct depression at mouth corner (Figs. 320, 476); postmarginal vein slightly longer than stigmal vein. *Female*: antenna with pedicel less than twice as long as broad; gaster slightly longer than mesosoma, acuminate 197

– Gena without depression; postmarginal vein not longer than stigmal vein. *Female*: antenna with pedicel at least twice as long as broad; gaster often shorter than mesosoma 198

197(196) *Female*: flagellum with 2 anelli and 6 funicular segments; head in dorsal view stout-transverse, with vertex changing into occiput far behind posterior ocelli. *Both sexes*: stigmal vein with stigma only very slightly capitate; propodeum as in Fig. 477, with region between plicae small and reticulate .... ***Catolaccus*** Thomson, see 263

– *Female*: flagellum with 3 anelli and 5 funicular segments; head in dorsal view arcuate, short medially, and with vertex changing into occiput less than 1 ocellar diameter behind posterior ocelli. *Both sexes*: stigmal vein distinctly capitate; propodeum as in Fig. 487, with region between plicae large and irregularly sculptured, and with short straight rugae along anterior and posterior margins .... ***Pseudocatolaccus*** Masi, see 292

198(196) Head massive (Figs. 238, 239), in lateral view gena very broad and, especially in male, almost flat and posteriorly with acute-angular edge (Fig. 238) (seen best in dorsal view); face at level of toruli strongly protuberant (Fig. 239); flagellum with both anelli large, subquadrate, and hardly narrower than pedicel; scape pale and very long; propodeum with median area about 3 times as broad as long and rounded on sides. [Gaster round.] .... ***Coelopisthia*** Förster

Fauna: At least 4 spp. **Hosts**: Tortricidae.

– Head often stout but not massive, with gena not broad and posteriorly without unusual sharp edge (Fig. 377); face at level of toruli only moderately protuberant; flagellum with anelli small and much narrower than apex of pedicel (Figs. 241, 246); scape usually metallic and not nearly as high as head; propodeum with median area less transverse 199

199(198) Marginal vein at most about 1.5 times as long as stigmal vein (Fig. 240); postmarginal vein either slightly shorter than or at most 1.1 times as long as stigmal vein; flagellum with anelli strongly transverse; face in lateral view not protuberant at level of toruli but upper face fairly convex. *Female*: gaster round (Figs. 234, 242) or ovate (Fig. 244) 200

– Marginal vein about twice as long as stigmal vein or longer (Fig. 377) (exceptionally, in *Dibrachys hians*, shorter than twice as long); postmarginal vein slightly shorter than stigmal vein; flagellum with second anellus usually only slightly transverse; face in lateral view sometimes protuberant at level of toruli (Fig. 452). *Female*: gaster ovate to elongate 202

200(199) Marginal vein almost 1.5 times as long as stigmal vein (Fig. 240). *Female*: flagellum with first funicular segment much shorter than pedicel and not obconical; clava acuminate apically (Fig. 241). *Male*: flagellum with first funicular segment oblong and swollen beneath .... ***Cyclogastrella*** Bukowski (part)

Fauna: 1 Holarctic sp., *C. deplanata* (Nees). **Hosts**: pupae of Tortricidae.

– Marginal vein slightly shorter to slightly longer than stigmal vein. *Female*: flagellum with first funicular segment at least as long as pedicel and often obconical; clava rounded apically. *Male*: flagellum with first funicular segment usually much longer and not swollen 201

201(200) Forewing hyaline; marginal vein slender, with area behind it not unusually densely setose; propodeum about half as long as scutellum, with plicae forming semicircular ridges curving towards median area (Fig. 244). *Female*: flagellum stout-filiform, with first funicular segment long, widening apically (Fig. 243) .... ***Conomorium*** Masi

Fauna: 1 sp., *C. pelor* Bouček (1993*b*), in eastern USA.

– Forewing in most species broadly infumate; marginal vein rather stout, with area behind it densely setose (Fig. 329); propodeum distinctly less than half as long as scutellum, with plicae vague but almost straight. *Female*: flagellum subclavate; first funicular segment short in species with short postmarginal vein .... ***Arthrolytus*** Thomson, see 275

202(199) Marginal vein more than 3 times as long as stigmal vein, the marginal vein and marginal setae separated slightly from anterior margin of wing (Fig. 249); thoracic dorsum either with parts strongly convex and dull, with sides of scutellum very steep, or (in another species) dorsum rather depressed and extensively smooth; clypeal margin only slightly wavy or produced and emarginate. *Female*: pedicel in dorsal view 2.5 times as long as broad. [Occiput not margined.] .... ***Systellogaster*** Gahan

Fauna/Hosts: 2 spp., *S. ovivora* Gahan in Canada (ON, PQ) and throughout USA in oothecae of cockroaches (Blattidae), and *S. gahani* Wallace in USA (IL, MO, VA).

– Marginal vein hardly more than twice as long as stigmal vein, the marginal vein and stronger setae right on anterior margin of wing; thoracic dorsum, including scutellum, slightly shiny because of rather superficial reticulation, and scutellum with sides not very steep; clypeal margin emarginate or excised medially 203

203(202) Occiput without trace of transverse fold or carina; lower face in lateral view mostly protuberant at or below level of toruli (Figs. 245, 246); scape often rather stout (Fig. 246) .... ***Tritneptis*** Girault

Key: Burks (1971). **Fauna**: at least 6 spp. **Hosts**: associated with Diprionidae and Lepidoptera, mainly on conifers.

– Occiput with indication of broadly arched carina or edge; lower face in lateral view usually not protuberant or, if slightly so, scape narrow (Fig. 247) .... ***Dibrachys*** Förster, see 193

204(184) Occiput with fine to strong, arched margin or fold (difficult to see if head abuts dorsally against pronotum) (Figs. 450, 453); flagellum with 2 anelli 205

– Occiput without such margin (Fig. 454) **or** flagellum with 3 short anelli 211

205(204) Head with fine, horseshoe-like occipital carina (with sides vertical, Fig. 251) near occipital foramen; head and thoracic dorsum unusually shiny, with reticulation on convex scutellum very weak; clypeal margin deeply excised medially; gena with distinct depression at mouth corner; torulus slightly below lower margin of eye. [Gaster flat, short-oval.] .... ***Duartea*** Bouček (part)

Fauna: 1 sp., *D. daphne* (Girault), in USA (CA, GA, TX, WA, VT). **Hosts**: pupae of Hemerobiidae, also reported as associated with Pseudococcidae. (See Bouček 1993*b*.)

– Head with broad arch-like occipital margin not close to occipital foramen (Fig. 453); head and thoracic dorsum, including scutellum, with distinct reticulation (though fine in *Nasonia*); clypeal margin not deeply emarginate; torulus slightly to distinctly above lower margin of eye 206

206(205) Torulus above middle of face (Fig. 252); flagellum with 2 very short anelli (Fig. 252); wing usually completely setose beyond basal vein. [Gaster usually at least partly yellow; propodeum with more or less well developed transverse ridge.] .... ***Chrysoglyphe*** Ashmead

Fauna: not yet found in North America, but 2 spp. described from St. Vincent sometimes misidentified in collections. (See Bouček 1993*b*.)

– Torulus at least slightly below middle of face; flagellum with anelli only moderately short (Figs. 237, 253); speculum usually present beyond basal vein 207

207(206) Mesoscutum shiny, with reticulation superficial and mostly engraved (Fig. 451); lower face strongly receding to mouth (Fig. 253); gena without depression; clypeal margin hardly emarginate. *Female*: antenna short, the flagellum with all funicular segments strongly transverse (Fig. 452) .... ***Nasonia*** Ashmead (part)

Fauna/Hosts: 3 spp., mainly the cosmopolitan *N. vitripennis* (Walker), in puparia of Diptera in bird nests. (See Darling and Werren 1990.)

– Mesoscutum at most slightly shiny, with reticulation conspicuous and raised (Fig. 453); lower face not strongly receding to mouth; other characters in part different 208

208(207) Metacoxa anterodorsally with distinct setae (Fig. 254); forewing with basal third broadly bare dorsally, but ventrally with extensive fine setae (Fig. 256); clypeus not produced, almost flat, with vertical striations; gena with small depression at mouth corner. *Male*: eye large (Fig. 255), its shortest diameter about 3 times malar space .... ***Gyrinophagus*** Ruschka

Fauna: 1 Holarctic sp., *G. aper* (Walker), in Canada (NB, ON). **Hosts**: cocoons of Gyrinidae.

– Metacoxa dorsally bare (Fig. 258); forewing, clypeus, and gena sometimes different. *Male*: eye not enlarged 209

209(208) *Female*: flagellum clavate and clava with micropilose area on at least 2 apical segments (Fig. 237). *Male*: antenna yellowish and stout; mouth very broad (Fig. 236). *Both sexes*: propodeum with irregular sculpture but with well-formed median carina extending to anterior margin of nucha; postmarginal vein only slightly longer than stigmal vein; eye with evident setae .... ***Diglochis*** Förster, see 192

– *Female*: flagellum at most slightly clavate and clava without micropilose areas. *Male*: antenna dark and flagellum filiform; mouth normal. *Both sexes*: propodeum with punctate, globose nucha; postmarginal vein distinctly longer than stigmal vein; eye usually bare 210

210(209) Eye virtually bare; forewing with large speculum and with basal cell more or less bare; pronotal collar not or hardly margined (Fig. 453). *Female*: flagellum at most slightly clavate .... ***Trichomalopsis*** Crawford (part)

Fauna: At least 15 spp. **Hosts**: usually cocoons of Coleoptera and pupae of Lepidoptera, often as hyperparasites through Braconidae and Ichneumonidae.

– Eye with distinct setae; forewing densely setose except for often small speculum (Fig. 259); pronotal collar distinctly margined. *Female*: flagellum distinctly clavate (Fig. 260) .... ***Urolepis*** Walker

Fauna/Hosts: 2 spp., *U. rufipes* (Ashmead) on Diptera pupae (Ephydridae, Muscidae, Tabanidae) in saline habitats or in dung, and *U. singularis* (Ashmead) [with apex of gaster produced in a spike (Fig. 261)] in eastern coastal marshes.

211(204) Metacoxa dorsally setose in basal third (Figs. 455, 457, 458); flagellum in most species with 2 anelli 212

– Metacoxa dorsally bare except often on mesal side in apical half with row of several long, erect setae, and occasionally with few setae laterobasally (*Stenetra*); flagellum with 2 or 3 anelli 218

212(211) Flagellum with 3 anelli and 5 funicular segments (Fig. 262); torulus distinctly below middle of face; propodeum lateral to plicae with thick white setae; pronotum margined with thin sharp carina .... ***Atrichomalus*** Graham

Fauna: 1 unidentified sp. close to European *A. trianellatus* Graham, in USA (NM). **Hosts**: probably associated with *Juniperus*.

– Flagellum with 2 anelli and 6 funicular segments; torulus often near middle of face; propodeal setae sometimes not very thick; pronotum margined or not 213

213(212) Postmarginal vein at least as long as marginal vein; forewing with stigma usually distinctly enlarged (Figs. 201, 265); propodeum laterally with setae long and thin but not dense (Fig. 454); Gt_1 laterally without unusual patch of long setae; propodeum without nucha, the foramen broad and subangular (Fig. 455); profemur and metafemur slightly broadened (Fig. 265). *Female*: gaster lanceolate 214

– Postmarginal vein generally shorter than marginal vein; forewing with stigma small; propodeum laterally usually with dense setae (Fig. 457); Gt_1 laterally often with patch of long, dense, white setae (Fig. 457); propodeum often with nucha, the foramen not broad; femora not broadened. *Female*: gaster more or less ovate, only very rarely lanceolate 216

214(213) Pronotum dorsally rounded, without carina or abrupt edge (Fig. 263); propodeum medially short, with median carina and incomplete plicae; forewing with stigma at most gradually broadening (Fig. 265) .... ***Rhopalicus*** Förster (part)

Key: Grissell (1983). **Fauna**: at least 3 spp. **Hosts**: Scolytidae on conifers.

– Pronotum with rectangular edge or sharp carina (Figs. 264, 454); other characters in part different 215

215(214) Pronotal collar with raised reticulate sculpture (Fig. 454), in lateral view with edge rectangular and in dorsal view collar only slightly longer laterally than medially (Fig. 267); propodeum short, with straight median carina; forewing with stigma small; clypeus laterally striate and apical margin subtruncate (Fig. 266). [Body, see Fig. 267.] .... ***Quercanus*** Heydon

Key: Heydon (1994). **Fauna**: 2 spp., *Q. luteogaster* Heydon and *Q. viridigaster* Heydon in USA (CA). **Hosts**: Cynipidae on *Quercus*.

– Pronotal collar more or less smooth, margined with sharp carina (Fig. 264), and in dorsal view posterior margin of pronotum deeply emarginate so collar more than twice as long laterally as medially; propodeum usually not short, with median carina irregular or incomplete (Fig. 455); forewing with stigma capitate; clypeus often completely reticulate or with apical margin emarginate .... ***Dinotiscus*** Ghesquière

Key: Grissell (1983). **Fauna**: 4 spp. **Hosts**: Scolytidae.

216(213) Pronotal collar margined with sharp carina (best seen with light from behind) (Fig. 456); Gt_1 laterally with dense patches of whitish setae (Fig. 457); mandibles each with 4 teeth. *Male*: head, antenna, and legs without distinctive features in most species .... ***Trichomalus*** Thomson

Fauna: several dozens of spp. **Hosts**: mostly small Curculionidae in herbaceous plants.

– Pronotal collar not sharply and continuously margined (Figs. 458, 459); Gt_1 laterally sometimes with sparser setae; left mandible with 3 teeth. *Male*: with distinctive features or color pattern either on gena or on middle legs and antenna 217

217(216) Propodeum with large, reticulate, laterally convex nucha; propodeum laterally densely setose but Gt_1 with only few setae laterally (Fig. 458); head relatively stout, at most 2.1 times as broad as long. *Female*: forewing usually with brown cloud (Fig. 268) or spots. *Male*: antenna and/or middle legs with distinctive color pattern; mesotibia often with lobes (Fig. 269); temple reticulate .... ***Spaniopus*** Walker

Fauna: 2 described and at least 4 undescribed spp. **Hosts**: Cecidomyiidae [*S. dissimilis* Walker on *Mayetiola destructor* (Say)] and probably other insects in galled parts of herbaceous plants, but 1 sp. reared as hyperparasite of *Phytonomus* (Curculionidae) through cocoons of *Bathyplectes* (Ichneumonidae).

– Propodeum posteriorly with broad triangular area (Figs. 270, 459, 460) or, if with reticulate nucha, the nucha delimited laterally by continuation of plicae; propodeum lateral to plicae and Gt_1 anterolaterally both densely setose (Fig. 459); head more transverse. *Female*: forewing hyaline. *Male*: antenna and legs not unusually distinctive but gena and temple with abruptly smooth strip (Fig. 288) .... ***Peridesmia*** Förster (part)

Fauna: 1 sp., *P. discus* (Walker), introduced from Europe. **Hosts**: eggs of *Hypera postica* (Gyllenhal) (Curculionidae) in alfalfa stems.

218(211) Clava acuminate (in some males less strongly so) or with a pointed bare spine (Figs. 272–274, 462) 219

– Clava neither distinctly acuminate nor with bare spine 224

219(218) Propodeum at least as long as scutellum and posteriorly constricted into distinct, punctate nucha (Fig. 158); flagellum with 3 anelli and 5 funicular segments (Figs. 157, 159); petiole, if visible, bordered ventrally by flange visible on either side and formed from extension of Gs_1; pronotum dorsally carinate .... ***Callitula*** Spinola, see 129

– Propodeum shorter than scutellum and **if**, at most, moderately constricted posteriorly **then** flagellum with only 2 anelli; gaster sessile; pronotum not carinate 220

220(219) *Female*: gaster subcircular. *Both sexes*: pronotum not margined, with collar indistinct; clava only slightly acuminate (Fig. 241); propodeum with median area between plicae cordiform and divided by median carina .... ***Cyclogastrella*** Bukowski, see 200

– *Female*: gaster ovate-acuminate to broadly lanceolate. *Both sexes*: pronotum dorsally rounded but with more or less indistinct horizontal collar; clava always distinctly acuminate; propodeum usually without median carina, its median area often different 221

221(220) Prepectus very small, dorsally much shorter than tegula (Fig. 461); gena with posteroventral corner carinate; head and thoracic dorsum with conspicuous white curved setae 222

– Prepectus triangular, dorsally longer than tegula (Fig. 465); gena posteriorly rounded; head and thoracic dorsum with inconspicuous setae 223

222(221) Clypeus with 2 distinct teeth (Fig. 463); propodeum with median carina, with shallow anterior depression bordered on each side by fovea and posteriorly by carinate edge, and with globose nucha (Fig. 464); metatibia with 1 apical spur. *Female*: flagellum with 3 anelli. *Male*: flagellum without distinct setae but densely covered with numerous longitudinal sensilla .... ***Lysirina*** Heydon

Fauna: 1 sp., *L. polychroma* Heydon (1994), in southwestern USA.

– Clypeus with anterior margin very shallowly emarginate or truncate; propodeum rather flat and featureless, with regular raised-reticulate sculpture (as in Fig. 466), and without distinct nucha; metatibia with 2 apical spurs. *Female*: flagellum with 2 anelli. *Male*: flagellum with whorls of long erect setae but few longitudinal sensilla .... ***Norbanus*** Walker

Fauna: several spp., 3 described. **Hosts**: unknown, but extralimital spp. on Cephidae in lower parts of stems of sturdy grasses and in twigs of bushes.

223(221) Flagellum with 2 anelli, with each funicular segment having 2 or more rows of longitudinal sensilla (male with funicular segments, especially the enlarged first segment, having several rows of sensilla), and with stout acuminate clava (female with clava having oblique sutures); propodeum medially more than half as long as scutellum, the median one-third almost in one plane and with very regular reticulate sculpture. *Female*: gaster convex and subcylindrical (Fig. 271) .... ***Merisus*** Walker

Fauna: 1 sp., *M. harmolitae* Gahan. **Hosts**: *Tetramesa* (Eurytomidae) in grass stems.

– Flagellum with 2 or 3 anelli, with each funicular segment usually having 1, but sometimes 2, rows of long, often sparse longitudinal sensilla (Fig. 273) (male with first funicular segment not enlarged), and with clava usually distinctly pointed, but if only acuminate then propodeum medially less than half as long as scutellum and less regularly sculptured. *Female*: gaster often more or less collapsing dorsally, usually ovate-acuminate .... ***Homoporus*** Thomson (part)

Fauna: at least 15 spp. **Hosts**: associated mainly with insects in stems of grasses and other herbaceous plants, and in thin twigs of bushes.

224(218) Clypeal margin with median tooth, the margin not broadly produced (Figs. 276, 467); flagellum with 2 anelli 225

– Clypeal margin without median tooth but, if margin produced and with 3 small lobes (Fig. 342), then flagellum with 3 anelli (see *Ottawita*, couplet 280) 227

225(224) Clypeus striate (Fig. 467); lower face with supraclypeal area flat and not separated from clypeus (Figs 467); pronotum often distinctly margined ....***Stenomalina*** Ghesquière (part)

Fauna: More than 10 spp. **Hosts**: associated with grass stems.

– Clypeus smooth or reticulate (Figs. 279, 403); lower face with supraclypeal area slightly convex and separated from clypeus by shallow groove (Fig. 403); pronotum with rounded collar edge 226

226(225) Propodeum with median carina complete and with distinct, angular plicae, the area between plicae flat and finely reticulate or almost smooth (as in Fig. 404); gaster ovate-acuminate, hardly longer than mesosoma; marginal vein narrow throughout. *Male*: flagellum with very short setae .... ***Thinodytes*** Graham, see 80

– Propodeum with median carina reduced to anterior, often toothlike elevation, and with irregular and incomplete plicae merging with rugulose-reticulate sculpture of median area; marginal vein slightly broadened basally (Fig. 277). *Male*: flagellum with distinct erect setae (Fig. 278) .... ***Hemitrichus*** Thomson (part)

Fauna: at least 2 spp., mainly the Holarctic *H. seniculus* (Nees). **Hosts**: reliable host records seem to be those of *Ptinus* (Ptinidae) and perhaps some other Coleoptera in stored products and litter.

227(224) Mesosoma strongly depressed **and** flagellum with 2 anelli; torulus below lower margin of eye; postmarginal vein only slightly longer than stigmal vein .... ***Zdenekiana*** Huggert, see 307

– Mesosoma not strongly depressed or, if so, flagellum with 3 anelli; other characters at least partly different 228

228(227) Forewing completely and densely setose, without speculum; eye densely setose 229

– Forewing usually extensively bare in basal third or at least with distinct speculum; eye at most with very short inconspicuous setae 230

229(228) Thoracic dorsum strongly convex, with dense setae (Fig. 280); femora and tibiae densely setose, and femora infuscate; pronotum not margined; forewing with combined length of marginal and postmarginal veins greater than costal cell; flagellum with 2 anelli and with subacuminate clava .... ***Arachnopteromalus*** Gordh

Fauna: 1 widespread sp., *A. dasys* Gordh. **Hosts**: egg sacs of spider, *Octonoba sinensis* (Simon) (Uloboridae).

– Thoracic dorsum slightly depressed, with scutellum flat and bare along median line; femora and tibiae sparsely setose, yellow; pronotum with sharply margined collar; forewing with combined length of marginal and postmarginal veins about equal to costal cell (Fig. 281); flagellum with 3 anelli. *Female*: flagellum slightly clavate, with claval apex rounded (Fig. 281). *Male*: flagellar segments bead-like (Fig. 282) .... ***Rakosina*** Bouček

Fauna: 1 sp., *R. deplanata* Bouček (1956), apparently introduced from Europe, in USA (NJ). **Hosts**: puparia of Diptera leafminer on corn.

230(228) Propodeum in dorsal view with posterior corner prominent as sharp or rectangular tooth (Fig. 283), the tooth (not to be confused with corner of metapleuron) formed by short vertical carina or lamella as seen in lateral view (Fig. 468); propodeum submedially often with indication of costula but nucha never large; flagellum with 2 anelli; thoracic dorsum extensively setose but setae dark, not conspicuous 231

– Propodeum in dorsal view **either** with posterior corner less prominent (obtuse or rounded) especially if costula present **or**, if corner relatively sharp, flagellum with 3 anelli; thoracic dorsum either nearly bare or setae pale 233

231(230) Metatibia with 2 distinct apical spurs (Fig. 285); gaster anteriorly with pale reddish cross-band; forewing hyaline and with basal cell almost completely setose (Fig. 284) .... ***Dimachus*** Thomson

Fauna/Hosts: perhaps 2 spp., mainly the Holarctic *D. discolor* (Walker) on *Ptinus fur* (L.) (Ptinidae).

– Metatibia with 1 apical spur (2 spurs in one European sp.); gaster usually dark metallic (pale anteriorly only in some teneral, not yet melanized *Arthrolytus*); forewing hyaline or with infumation and with basal cell almost completely bare 232

232(231) Gaster with cercus having at least 1 very long sinuate seta reaching or exceeding its apex (Fig. 287); Gt_1 and Gt_2 often with posterior margins produced in slight arch (Fig. 287); forewing hyaline, rarely with small cloud behind parastigma, and moderately setose .... ***Lariophagus*** Crawford (part)

Fauna/Hosts: 4 spp., on Coleoptera (probably mainly Anobiidae), including the cosmopolitan *L. distinguendus* (Förster) (Figs. 286, 287, 468) in stored grain, particularly on *Sitophilus granarius* (L.) (Curculionidae) and *Stegobium paniceum* (L.) (Anobiidae).

– Gaster without exceedingly long cercal setae; Gt_1 and Gt_2 with posterior margins not produced; forewing, especially in female, usually with broad infumation behind marginal vein and with disc densely setose .... ***Arthrolytus*** Thomson, see 275

233(230) *Male only*: head with temple, and often vertex and face, having well delimited smooth lines or bands (Figs. 288–290) 234

– *Both sexes*: head without smooth lines or bands 236

234(233) Head with broad smooth band on gena continuing along temple for about three-quarters height of eye (Fig. 288); flagellum with 2 short anelli; metacoxa dorsally with some setae .... ***Peridesmia*** Förster, see 217

– Head with curved, smooth lines on gena, temple, face, and vertex (Fig. 289, 290); flagellum different; metacoxa dorsobasally bare 235

235(234) Flagellum with 3 anelli; face with smooth lines narrow and strongly curved (Fig. 289) .... ***Meraporus*** Walker, see 306

– Flagellum with third segment as long as broad (Fig. 290); face with smooth lines relatively broad (Fig. 290) .... ***Leptomeraporus*** Graham (part)

Fauna: 1 sp., *L. decoratus* Boucek (1993*b*), in USA (AZ, VA).

236(233) Flagellum with 2 anelli and 6 funicular segments (i.e., third flagellar segment, even if short, with longitudinal sensilla) 237

– Flagellum with 3 anelli and 5 funicular segments (fourth and following segments with longitudinal sensilla) 277

Note: males of some genera that should key with females through this couplet may have only 2 anelli; but males of many spp. are not yet known.

237(236) Propodeum between plicae with distinct transverse costulae (sometimes weaker submedially) delimiting two anterior transverse areas, the areas either with regular raised-reticulate sculpture (Fig. 469) or shiny but then costulae fairly strong (Fig. 292) 238

– Propodeum without such regular costulae or **if** with a similar vague feature (some *Pteromalus*) **then** anterior areas shiny, rugulose, or smooth 240

238(237) Propodeum with anterior areas shiny between some rugulae, with costula irregular (Fig. 292); propodeum medially more than half as long as scutellum .... ***Staurothyreus*** Graham

Fauna: 1 undescribed sp. in Canada (AB).

– Propodeum rather dull because of regular, though often weak but still dense, reticulation; propodeum usually distinctly shorter 239

239(238) Gena without depression; pronotal collar conspicuous, reticulate, and anteriorly carinate; clypeal margin not produced; propodeum as in Fig. 469; flagellum filiform, with setae inconspicuous, not on tubercles and never in whorls .... ***Ablaxia*** Delucchi

Fauna: about 10 undescribed spp. **Hosts**: unknown, but European species recorded from Scolytidae and Curculionidae in twigs (Bouček and Rasplus 1991).

– Gena with distinct depression at mouth corner; pronotal collar extremely short, not distinctly reticulate, and carinate or not; clypeal margin produced beyond paraclypeal lobes (Fig. 482); propodeum as in Fig. 483. *Female*: flagellum clavate, with large micropilose area midventrally on apical half of clava (Fig. 295). *Male*: flagellum with pedunculate segments and with setae on small tubercles, the setae erect and in whorls, rarely decumbent (Fig. 296) .... ***Psilocera*** Walker, see 281

240(237) Pronotum subconical, sloping from posterior margin, without indication of margined collar (Fig. 291); propodeum shiny, without plicae, in female medially very short. *Female*: gaster pointed at apex. *Both sexes*: gaster anteriorly, as well as all legs, pale yellowish .... ***Stinoplus*** Thomson

Fauna: about 5 spp., including *S. etearchus* (Walker), in USA (IL, VA). **Hosts**: galls of *Phanacis taraxaci* (Ashmead) (Cynipidae) [in Europe and Australia in galls of *P. hypochoeridis* Kieffer on *Hypochoeris radicata*].

– Pronotum not conical, with distinct, sometimes very short collar delimited anteriorly by blunt or sharp transverse edge (Figs. 470, 473) and/or the sloping neck very steep, sometimes vertical; propodeum more or less sculptured; gaster in most species not pale anteriorly and legs variable in color 241

241(240) Head stout, in dorsal view less than 1.8 times as broad as long, with high convex vertex (Figs. 293, 294); eye small, maximum length less than 0.7 times breadth of upper face (Fig. 294); thoracic dorsum depressed; propodeum rugose-reticulate, with distinct though slightly irregular median carina and plicae. *Female*: flagellum shorter than breadth of upper face; gaster ovate, about as long as mesosoma .... ***Gbelcia*** Bouček

Fauna: 1 sp., *G. cordilurae* Bouček (1993*b*), in USA (NY, VA, WV). **Hosts**: leafmining Scatophagidae.

– Head more transverse; eye relatively much larger; flagellum longer; other characters different 242

242(241) *Female*: gaster subcircular (Figs. 297, 301) to short-ovate (Fig. 470), shorter than mesosoma, and with apex bluntly rounded (Fig. 471); propodeum subhorizontal, not short (Figs. 297, 301) 243

– *Female*: gaster lanceolate or, if less than twice as long as broad, apex appearing at least slightly pointed due to acute-angular last tergum and slightly produced tips of ovipositor sheaths; propodeum short or long 249

243(242) Propodeum with sharp median carina and plicae, the subcordiform median area shiny; torulus at middle of face (*A. breviscapus*, Fig. 303) or conspicuously above middle. *Male*: funicular and claval segments basally each with whorl of setae .... ***Apsilocera*** Bouček

Fauna: 2 spp., *A. breviscapus* Bouček (1993*b*) in USA (VA) and 1 undescribed sp. in USA (MI). **Hosts**: unknown, but the European *A. bramleyi* Graham occurs in galls of *Mycocecis* (Cecidomyiidae) in fungi.

– Propodeum either distinctly reticulate or median carina and plicae incomplete (Fig. 472); torulus at or below middle of face in almost all species; other characters different 244

244(243) Clypeus convex, shiny, its apical margin arcuately produced (Fig. 299); mouth small, hardly more than 1.5 times as broad as length of malar space. *Female*: funicle with segments loose, each with unusually strong and long longitudinal sensilla clearly exceeding apex of segment; gaster subovate. *Both sexes*: propodeum with plicae and median carina distinct, the area between them reticulate .... ***Endomychobius*** Ashmead

Fauna: 1 widespread but uncommon sp., *E. flavipes* Ashmead. **Hosts**: *Endomychus biguttatus* Say (Endomychidae).

– Clypeus, if produced, not arcuate and mouth relatively larger; funicle with segments close to each other and longitudinal sensilla different; propodeum only rarely with median carina, the other features also partly different 245

245(244) *Female*: flagellum clavate, the clava asymmetric, with micropilose area extending over at least apical half (Figs. 310, 311) .... ***Sceptrothelys*** Graham, see 256

– *Female*: flagellum with clava not having such micropilose area (males not well known) 246

246(245) Gena depressed ventrally and more or less depressed at mouth corner (Fig. 302); clypeus with 2 broad teeth or lobes. *Female*: flagellum with pedicel less than 1.5 times as long as broad and funicular segments transverse or quadrate 247

– Gena not extensively depressed and without genal depression; other characters at least in part different. *Female*: flagellum with pedicel at least twice as long as broad and funicular segments quadrate to elongate 248

247(246) *Female*: flagellum with conspicuous semierect setae and sparse longitudinal sensilla (Fig. 302); clypeal margin bilobed; gaster circular, much shorter than mesosoma (Fig. 301), yellowish .. .. ***Kratka*** Bouček

Fauna: 1 sp., *K. circularis* Bouček (1993*b*), in USA (NE).

– *Female*: flagellum without unusual setae (Fig. 319) and rather dense longitudinal sensilla; clypeal margin with 2 strong teeth; gaster ovate, about as long as mesosoma, metallic .... ***Kukua*** Bouček, see 262

248(246) *Female*: gaster with apex formed by transversely convex last tergum, the stout and setose ovipositor sheaths not extending to very apex and visible only in posteroventral view (Figs. 300, 471); antenna with basal funicular segments distinctly elongate, with length of flagellum plus pedicel almost to fully as long as width of head, and with scape at least slightly exceeding level of vertex. *Both sexes*: mouth corner normal .... ***Tomicobia*** Ashmead (part)

Fauna: At least 9 spp. **Hosts**: adult Coleoptera in conifers or *Quercus*, including *T. tibialis* Ashmead on Scolytidae and another sp. on Curculionidae.

– *Female*: gaster with apex normal, the ovipositor with apex usually slightly protruding; antenna with basal funicular segments hardly longer than broad, length of flagellum plus pedicel shorter than width of head (Fig. 297). *Male*: mouth corner broadly circular (Fig. 298). [Propodeum, see Fig. 472.] .... ***Psychophagus*** Thomson

Fauna: 1 Holarctic sp., *P. omnivorus* (Walker). **Hosts**: primary or secondary parasite of pupae of various Symphyta and nocturnal Lepidoptera.

249(170, 242) Pronotum with collar margined by sharp edge, the edge either a smooth carina (best seen with light from behind) (Fig. 473) or edge, at least medially, distinctly raised above collar surface 250

– Pronotum with collar only more or less margined, the edge varying from blunt to abruptly angled but then not smoothly carinate, upon close examination some parts of net-like sculpture detectable on very edge 261

250(249) Vertex usually with carinate, obtuse-angular, transverse ridge about 1 ocellar diameter behind posterior ocelli (Fig. 304); propodeum medially with tranverse blunt ridge, the ridge more reticulate than other parts of propodeum and in most cases apparent as tubercle where it crosses incomplete median carina; propodeal plicae rarely complete, mostly indicated posteriorly on sides of short nucha; mandibles each with 3 teeth. *Female*: gaster long, lanceolate, sometimes with last tergum produced into narrow, compressed stylus .... ***Holcaeus*** Thomson (part)

Fauna: several spp., all probably undescribed, at least 2 widespread.

– Vertex without such transverse ridge; propodeum and other characters in part different 251

251(250) Flagellum long and cylindrical (Figs. 305, 306, 309), in female length of flagellum plus pedicel at least about 1.1 times as long as breadth of head, and always with at least 4 funicular segments longer than broad 252

– Flagellum relatively short, its length plus pedicel usually not longer than breadth of head, and most funicular segments quadrate or even transverse 256

252(251) Flagellum stout-cylindrical, much broader than pedicel, with each funicular segment having at least 2 rows of longitudinal sensilla (Fig. 305); marginal vein about 1.3 times as long as stigmal vein, the latter moderately capitate; body broad, with mesoscutum almost as broad as combined length of mesoscutum and scutellum .... ***Capellia*** Delucchi

Fauna: 2 spp. **Hosts**: galls of Cecidomyiidae on conifers.

– Flagellum mostly slender-filiform, about as broad as pedicel, with each funicular segment either having 1 row of longitudinal sensilla or, if with 2 rows, marginal vein at least 1.4 times as long as stigmal vein, the latter not evidently capitate; body less sturdy 253

253(252) Torulus at lower margin of eye; flagellum with clava parallel-sided and fully 3 times as long as broad (Fig. 306); prepectus shiny, with posterior margin only as long as dorsal margin; thorax short, its dorsal length (from carina of collar to apex of scutellum) less than 1.2 times width of mesoscutum; propodeum with cordiform median area defined by posteriorly high plicae and divided by straight median carina .... ***Heteroprymna*** Graham

Fauna: at least 1 unidentified sp. found on apple leaves (*Malus*).

– Torulus above lower margin of eye; flagellum with clava short; prepectus reticulate, with posterior margin distinctly longer than dorsal margin (Fig. 475); mesosoma considerably longer; propodeum with median carina and plicae irregular and/or incomplete, the area between them not cordiform (Fig. 474) 254

254(253) *Female*: gaster long and tapered into narrow tail formed by extremely long and compressed last tergum, the tergum clearly longer than one-third length of entire metasoma (Fig. 309). *Both sexes*: postmarginal vein at least about as long as marginal vein; head behind ocelli with dorsally blunt, transverse crest .... ***Eulonchetron*** Graham

Fauna: 2 Holarctic spp., *E. giraulti* (Peck) (= *E. scalprum* Askew) (Heydon and Bouček 1992) and *E. torymoides* (Thomson) in southern Canada and northern USA. **Hosts**: galls of *Pontania* (Tenthredinidae) on leaves of *Salix*.

– *Female*: gaster not as elongate, the last tergum much shorter or, if approaching one-third length of metasoma, the vertex behind ocelli with carinate crest (some *Holcaeus*). *Both sexes*: postmarginal vein usually shorter than marginal vein; head different 255

255(254) *Female*: clava with ventral micropilose area on 2 apical segments. *Both sexes*: propodeum raised in transverse strip across middle, with extensive irregular reticulation and with postspiracular sulcus distinct .... ***Holcaeus*** Thomson, see 250

– *Female*: clava with at most minute micropilose patch on apical segment. *Both sexes*: propodeum without raised transverse strip across middle, but mesal to spiracle usually with weakly sculptured elongate depression well delimited on mesal side (Fig. 474), and with postspiracular sulcus often shallow or absent .... ***Chlorocytus*** Graham, see 258

256(251) *Female*: flagellum clavate (Figs. 310, 311), the clava with at least slightly oblique sutures due to elongate micropilose area extending over at least apical half of clava midventrally. *Both sexes*: propodeum with convex, reticulate nucha .... ***Sceptrothelys*** Graham (part)

Fauna/Hosts: at least 3 spp., including the Holarctic *S. deione* (Walker) on small Lepidoptera such as *Coleophora* (Coleophoridae), and 2 other spp. on *Phytonomus* (Curculionidae).

– *Female*: flagellum not unusually clavate, at most with small micropilose area or, **if** micropilose area about half length of clava and clava asymmetric (some *Chlorocytus*), **then** propodeum without distinct nucha 257

257(256) Flagellum with second anellus subquadrate (Fig. 307); torulus at lower margin of eye; pronotum with large, dorsally flat collar separated from vertical neck by subacute margin (Fig. 307); propodeum with median area almost smooth and only about 1.3 times as broad as long medially, with irregular median carina and with only slightly sinuate plicae (Fig. 308) .... ***Eumacepolus*** Graham

Fauna: 1 sp., *E. salicis* Bouček (1993*b*), in Canada (MB, ON).

– Flagellum with both anelli transverse; some other characters also different 258

258(257) Mesosoma long, with mesonotum at least 1.7 times as long as broad (Figs. 313, 473), and with propodeum generally long (Fig. 474); pronotal collar with raised, medially high but not quite sharp margin fading out in lateral one-quarter, and collar in dorsal view very short medially but with subparallel sides about half as long as width of pronotum. [Prepectus large and flat, extending behind procoxa ventral to propleuron, Fig. 475.] ... . ***Chlorocytus*** Graham (part)

Fauna: probably more than 12 spp. **Hosts**: associated mainly with grass stems.

– Mesosoma much shorter, with mesonotum at most about 1.4 times as long as broad, and propodeum not very long; pronotal collar with margin hardly raised but extending farther laterally, the collar in dorsal view with sides converging and much shorter 259

259(258) Pronotum with collar margin thin and sharp (Fig. 312), appearing as a fine smooth line; forewing with basal cell extensively setose, at least in basal half; propodeum more than half as long as scutellum; mesosoma slightly depressed, about 1.3–1.4 times as long as broad; scutellum weakly raised-reticulate or engraved-reticulate; body bronze-green, legs brown .... ***Pegopus*** Förster

Fauna: at least 1 unidentified sp. in Canada (NS) and USA (AK, MI).

– Pronotum with collar margin sharp but mostly not appearing as smooth line; forewing with basal cell often bare or, if extensively setose, mesosoma not depressed and propodeum less than half as long as scutellum; scutellum raised-reticulate; body usually green, legs partly yellow 260

260(259) Clypeus with apical margin deeply excised medially; forewing rather densely setose, with basal cell almost completely setose; propodeum medially almost one-third as long as scutellum .... ***Caenacis*** Förster

Fauna: probably several spp. **Hosts**: in galls of Cynipidae.

– Clypeus with apical margin shallowly emarginate medially; forewing less densely setose, with basal cell bare; propodeum less than one-quarter as long as scutellum (Fig. 318) .... ***Cecidostiba*** Thomson

Fauna: several spp. **Hosts**: in galls.

261(249) Gena with distinct depression at mouth corner (Figs. 320, 476) 262

– Gena without distinct depression, at most with a narrow groove at mouth margin 264

262(261) *Female* (male unknown): eye only about 1.25 times as long as broad; head in dorsal view strongly transverse-arcuate, more than 2.3 times as broad as long; clypeal margin deeply excised, with pit between 2 strong teeth (Fig. 319); gaster subcircular, but ovipositor sheaths slightly protruding; propodeum with plical foveae extending as large, depressed, sublateral areas posteriorly delimited by costula, and with plicae evident only on sides of nucha .... ***Kukua*** Bouček (part)

Fauna: 1 sp., *K. clypeata* Bouček (1993*b*), in Canada (ON) and USA (VA).

– *Both sexes*: eye at least 1.5 times as long as broad (Fig. 320); head less strongly transverse, appearing only slightly arcuate; clypeal margin slightly emarginate (Fig. 476). *Female*: gaster oval to elongate; other characters in part also different 263

263(262) Head (Fig. 320) in dorsal view at most about twice as broad as long, usually stouter; forewing behind marginal vein with rather dense, extensive setae, without visible admarginal row of setae on underside; propodeum with plica visible on side of depression of short apical constriction (Fig. 477) ....
.... ***Catolaccus*** Thomson (part)

Key: Burks (1954). **Fauna**: about 7 spp. **Hosts**: primary or secondary parasites in cocoons of Lepidoptera and Coleoptera.

– Head distinctly more transverse; forewing behind marginal vein with bare area on upper surface extending to stigmal vein, revealing 1 or 2 rows of conspicuous admarginal setae on underside (Figs. 349, 350); propodeum without trace of plica on side of apical constriction (Fig. 490) ....
.... ***Lyrcus*** Walker, see 303

264(261) Mesopleuron completely reticulate, including upper mesepimeron (as in Fig. 433) 265

– Mesopleuron with at least upper mesepimeron mainly shiny and without distinct reticulation (as in Figs. 435, 475) 266

265(264) Thoracic dorsum depressed; torulus distinctly below middle of face (Fig. 314); clypeus finely strigose, with apical margin produced and emarginate. *Female*: propodeum without median carina and as densely and deeply reticulate as mesoscutum ....
.... ***Abomalus*** Bouček

Fauna: 1 sp., *A. masoni* Bouček (1993*b*), in Canada (NT).

– Thoracic dorsum not depressed; torulus close to middle of face; clypeus reticulate at least medially, and with apical margin truncate .... ***Trychnosoma*** Graham

Fauna: 1 unidentified sp. in Canada. **Hosts**: probably associated with *Pinus*.

266(264) Metatibia with 2 distinct apical spurs; flagellum with each funicular segment having 2 rows of longitudinal sensilla; prepectus very small, dorsally much shorter than tegula .... ***Stenetra*** Masi

Fauna: probably 3 undescribed spp. in USA.

– Metatibia with only 1 distinct apical spur; flagellum with most funicular segments having 1 row of longitudinal sensilla; prepectus often larger 267

267(266) Prepectus very small (Fig. 478), less than half as long as tegula, and at about right angle to mesopleuron; pronotum much narrower than mesoscutum, its sides closely applied to mesoscutum, without shoulders (Fig. 479); mesoscutum with delicate, relatively large cells of reticulation (Fig. 479). *Female*: flagellum slender, with basal segments at most only as broad as slender pedicel (Figs. 315, 316); forewing with stigmal vein almost as long as marginal vein (Fig. 317) .... ***Guolina*** Heydon

Key: Heydon (1994). **Fauna**: at least 3 spp. **Hosts**: associated with Cynipidae on *Quercus*.

– Prepectus larger (at least as in Fig. 335) and in about same plane as mesopleuron; pronotum usually with distinct shoulders; mesoscutum with coarser, smaller meshes of reticulation. *Female*: flagellum broader than pedicel (Figs. 334, 336); forewing with stigmal vein often shorter (Fig. 325) 268

268(267) Propodeum reticulate, without plicae or median carina, the short nucha dorsally with arcuate elevation (Fig. 322) and laterally with extension of supracoxal flange; upper face very broad, its breadth 0.8 times height of head; torulus at lower margin of eye; clava asymmetric (Fig. 323); pronotum with side short and separated from lateral corner of mesoscutum by distinct deep notch (Fig. 321) .... ***Euteloida*** Bouček

Fauna: 1 sp., *E. subnigra* Bouček (1993*b*), in USA (VA) and Mexico.

– Propodeum different, at least part of plicae and/or median carina present, and with nucha different when present; upper face narrower, torulus often above lower margin of eye; pronotum with side longer and usually not separated from mesoscutum by deep notch 269

269(268) *Female*: antenna with pedicel at least twice as long as broad and longer than first funicular segment 270

– *Female*: antenna with pedicel generally less than twice as long as broad or, if as long as above, shorter than first funicular segment 271

270(269) *Female*: toruli almost in middle of face; antenna with thin scape, with flagellum narrowed in basal half, and with clava asymmetric because of collapsing micropilose area; pronotum short. [*Male*: head with smooth curving lines (Fig. 290).] .... ***Leptomeraporus*** Graham, see 235

– *Both sexes*: torulus distinctly below middle of face (Fig. 326); scape and flagellum not unusually thin and with clava symmetric; pronotum medially at least one-sixth as long as mesoscutum (Figs. 325, 493), often with raised collar margin. [*Male*: head without smooth lines.] .... ***Mesopolobus*** Westwood, see 306

271(269) Petiole (best seen from behind) with narrow, smooth median part posteriorly embraced from below by a broad, almost rectangular extension of Gs_1 (Figs. 324, 480); propodeum with plicae continuing on sides of nucha as parallel ridges almost to its apex (Fig. 480) .... ***Hypopteromalus*** Ashmead

Fauna: 3 widespread spp. **Hosts**: hyperparasites of Lepidoptera through cocoons of Braconidae.

– Petiole short, different, mostly concealed (Figs. 483–485); propodeum with plicae convergent posteriorly and usually not reaching apex of nucha (if nucha distinct, as in some *Pteromalus*, Fig. 334) 272

272(271) Forewing with stigma distinctly capitate, round (Fig. 327). *Female*: gaster subconical, usually reddish at base .... ***Phaenocytus*** Graham

Fauna/Hosts: 1 sp., *P. glechomae* (Förster), introduced into Canada (ON) from Europe with its host *Liposthenes glechomae* (L.) (Cynipidae) in galls on *Glechoma hederacea*.

– Forewing with stigma not distinctly capitate. *Female*: gaster not reddish 273

273(272) Pronotum dorsally rounded, not margined (Fig. 328); propodeum with median area having raised-reticulate sculpture, without distinct median carina; postmarginal vein at least as long as marginal vein .... ***Lampoterma*** Graham

Fauna: 1 unindentified sp. in USA (CA).

– Pronotum margined, at least medially; propodeum different, either with some shiny areas or with more or less distinct median carina; postmarginal vein usually shorter than marginal vein 274

274(273) Mesosoma about twice as long as broad (Fig. 313); propodeum subhorizontal, with only vague irregular plicae, and with median area between plicae about as broad as median length of propodeum (Fig. 474) .... ***Chlorocytus*** Graham, see 258

– Mesosoma shorter; propodeum different 275

275(274) Forewing usually with large brown infumation (mainly in female), the infumate area densely setose (Fig. 329); stigmal vein often almost as long as marginal vein; propodeum often with some indication of costula and with posterior corner more or less tooth-like; pronotal collar with obtuse-angular margin. *Female*: flagellum moderately clavate, with first funicular segment usually broadening apically (Figs. 330*a*, 330*b*). *Male*: flagellum long and densely setose (Figs. 331, 332) .... ***Arthrolytus*** Thomson (part)

Key: Burks (1969*a*). **Fauna**: several spp. **Hosts**: associated with galls of Cynipidae on *Quercus*.

– Forewing hyaline, usually less densely setose on disc; stigmal vein two-thirds to four-fifths length of marginal vein; propodeum without costula and with posterior corner obtuse; pronotal collar with rounded to abrupt margin (Figs. 333, 335) or very rarely margin obtuse-angular. *Female*: flagellum in most species filiform, with first funicular segment not broadening apically. *Male*: flagellum often different 276

276(275) Head in dorsal view relatively thin, at least 2.1 times as broad as long, and in anterior view genae curved and strongly converging. *Female*: gaster with hypopygium exceeding middle (Fig. 333) .... ***Spintherus*** Thomson

Fauna/Hosts: probably 2 spp., mainly the Holarctic *S. dubius* (Nees) on *Apion* (Apionidae) in clover heads.

– Head in dorsal view stouter (Fig. 334) and in anterior view genae moderately converging, not so curved as above [rarely mouth margin outside of clypeus produced (Fig. 336)]; hypopygium not reaching as far .... ***Pteromalus*** Swederus

Fauna: about 40 described and dozens of undescribed spp. **Hosts**: mainly pupae of Lepidoptera, Coleoptera, and their Hymenoptera parasites [the Holarctic *P. platyphilus* Walker in USA (OH) in spider (Araneae) egg sacs].

277(236) Lower face with deep, hole-like tentorial pits nearer to each other than to mouth margin (Fig. 481); postmarginal vein not or only slightly longer than stigmal vein, the latter distinctly to strongly capitate (Fig. 337); torulus in upper third of face; flagellum long and almost bare, with each funicular segment at least twice as long as broad and with 2 to 4 rows of longitudinal sensilla (Fig. 338) .... ***Acaenacis*** Girault

Fauna: 2 spp. **Hosts**: associated with galls of Cynipidae on *Quercus*.

– Lower face without conspicuous tentorial pits, the pits at most indicated by broad, shallow depressions; postmarginal vein much longer than stigmal vein, the latter in most species not capitate; torulus only rarely as high on face; flagellum different 278

278(182, 277) Head in dorsal view subglobose (Fig. 339), less than 1.6 times as broad as long; flagellum with funicular segments very short and transverse, the basal funicular segments often hardly different from anelli (Fig. 340); propodeum shiny, without distinct sculpture, short, and without nucha but with median carina indicated; body very narrow .... ***Hlavka*** Bouček

Fauna: 1 sp., *H. gibsoni* Bouček (1993*b*), in USA (AZ).

– Head in dorsal view much more transverse; flagellum with 3 anelli, the anelli different from the 5 funicular segments; propodeum with evident sculpture and other characters different; body in most species more robust 279

279(278) Propodeum with distinct regular costula, although part of costula sometimes weak; propodeum with reticulate sculpture, hence more or less dull (Figs. 483–485) 280

– Propodeum **either** without distinct costula, at most with blunt, transverse swelling traceable behind sublateral fovea, **or** with costula irregular, not straight; propodeum with sculpture usually different (Figs. 486–489) 291

280(279) Clypeus produced and apical margin with 3 small teeth (Fig. 342); lower face strongly convex and shiny along median line; torulus high above middle of face (Fig. 342); scape far exceeding level of vertex (Fig. 341) .... ***Ottawita*** Bouček

Fauna: 1 sp., *O. masneri* Bouček (1993*b*), in Canada (ON).

– Clypeus different, the apical margin not 3-toothed; lower face different; torulus often much lower on face; scape only rarely exceeding vertex (see *Alticornis*, couplet 290) 281

281(280) *Female*: flagellum clavate, the clava with midventral micropilose area, hence claval sutures oblique, and with first funicular segment long and much wider apically than basally (Fig. 344). *Male*: flagellum with narrow peduncles between funicular segments and each segment either having whorl of erect bristles or many subdecumbent bristles (Figs. 345, 346). *Both sexes*: propodeum with reticulate nucha (Figs. 343, 483), the nucha often concealing narrow, smooth petiole; head much broader than mesoscutum; gaster with posterior margins of several terga usually having median indentation. [Clypeus with 2 distinct teeth (as in Fig. 482, but emargination between them often shallow).] .... ***Psilocera*** Walker (part)

Fauna: at least 15 spp. [one of them, based on conical projection on scutellum, is *P. clavicornis* (Ashmead) (formerly in *Acanthometopon*)]. **Hosts**: unknown, but some extralimital species reared from cocoons of Chrysomelidae in soil.

– *Female*: flagellum different, if with micropilose area (Fig. 352) then not clavate. *Male*: flagellum different. *Both sexes*: propodeum with or without nucha, petiole always shorter, different, in particular without subcylindrical median part; head often not unusually broad, with at most weakly developed clypeal teeth, and terga without median incisions 282

282(281) Propodeum posteriorly not strongly produced or if short nucha indicated then not or hardly reticulate, not subglobose (Figs. 490, 491), and at least twice as broad as long; forewing with ventral surface behind marginal vein often having 1 or 2 rows of conspicuous admarginal setae (Figs. 349, 350) (some *Lyrcus*, see couplet 287) 283

– Propodeum posterior to costula narrowed into convex, reticulate nucha produced distinctly beyond supracoxal flange (Figs. 351, 485, 486); forewing with ventral surface behind parastigma and marginal vein having at least 3 rows of relatively short setae 288

283(282) Notauli, at least in some lights, appearing complete though very shallow posteriorly; clypeal margin with slight median convexity (Fig. 347); body with bright metallic colors, over 3 mm long, and with conical gaster (Fig. 348). [Metatibia with 2 spurs.] .... ***Conigastrus*** Bouček (part)

Fauna: 1 sp., *C. versicolor* Bouček (1993*b*), in USA (FL) [another sp. in Costa Rica].

– Notauli distinctly incomplete; clypeal margin without median convexity; body with colors dull, dark though usually metallic green, bronze, or bluish, usually smaller, and gaster usually not conical 284

284(283) Gt_1 with posterior margin broadly emarginate (Fig. 354); flagellum shorter than breadth of upper face, the funicular segments strongly transverse; clypeal margin with deep median incision (Fig. 353). *Female*: hypopygium exceeding three-quarters length of gaster .... ***Nadelaia*** Bouček (part)

Fauna: 1 sp., *N. ficus* Bouček (1993*b*), in USA (FL). **Hosts**: figs of *Ficus citrifolia*.

– Gt_1 with posterior margin straight or medially produced; flagellum longer; clypeal margin less deeply excised, usually shallowly emarginate. *Female*: hypopygium not reaching as far 285

285(284) Metatibia with 2 apical spurs (outer spur sometimes very short in species from far southern edge of region); forewing with ventral surface behind marginal vein having uniformly short setae; propodeum with obliquely angled costula reaching median carina in its anterior third (Figs. 355, 484) .... ***Neocatolaccus*** Ashmead

Key: Bouček (1993*b*). **Fauna**: at least 4 spp. in southern USA. **Hosts**: Curculionidae or Cerambycidae.

– Metatibia with 1 apical spur; forewing with ventral surface behind marginal vein often having 1 or 2 rows of conspicuous longer admarginal setae; propodeum with weak or irregular costula 286

286(285) Gena with depression at mouth corner; Gt_1 with posterior margin angularly or arcuately produced .... ***Eurydinoteloides*** Girault

Note: not yet found in Nearctic region; several Neotropical spp., one reared from pupae of Syrphidae.

– Gena without depression or, if slightly depressed, Gt_1 with posterior margin not angularly produced 287

287(286) Propodeum with sharp but irregular costula. [Antenna, see Fig. 356.] .... ***Holcaeus*** (***Cricellius*** Thomson), see 300

– Propodeum with weak, blunt, regular costula .... ***Lyrcus*** Walker, see 303

288(282) *Female*: clava with long, narrow, midventral micropilose strip (Fig. 352). *Both sexes*: propodeum with costula developed only at plicae (Fig. 351) and median carina weak or absent; gena with depression at mouth corner .... ***Synedrus*** Graham

Fauna: at least 1 sp., very similar to European *S. transiens* (Walker), in USA (New England states south to VA).

– *Both sexes*: clava without long micropilose strip; propodeum with median carina and costula more developed; gena usually without depression 289

289(288) Gena with depression at mouth corner (Fig. 161); occiput sloping behind ocelli and then abruptly changing plane along arcuate edge to deeply hollowed part around occipital foramen; head much broader than mesosoma; mesoscutum strongly transverse; metatibia with 1 apical spur .... ***Propodeia*** Bouček, see 132

– Gena without depression; occiput gradually changing plane, without conspicuous hollow around occipital foramen; head not unusually broad; mesoscutum moderately transverse; metatibia with 2 apical spurs 290

290(289) Torulus above middle of eye; scape greatly exceeding vertex; thoracic dorsum depressed; propodeum with nucha rather shiny. *Female*: gaster short. *Male*: flagellum with 2 anelli and 6 funicular segments .... ***Alticornis*** Bouček, see 146

– Torulus not or hardly above middle of eye, in most species below this level (Fig. 362); scape at most moderately exceeding vertex; thoracic dorsum not depressed; propodeum with nucha reticulate, subglobose (Fig. 485). *Female*: gaster often elongate and acuminate. *Male*: flagellum with 2 or 3 anelli .... ***Heteroschema*** Gahan (part)

Fauna: at least 12 spp., mainly in southern part of region. **Hosts**: some spp. on Agromyzidae.

291(279) Propodeum short, with sides tapering into subconical globose nucha from as far laterally as level of spiracles (Figs. 359, 486), reticulate, without median carina, and with plicae at most vaguely indicated anteriorly; mesosoma less than 1.3 times as long as broad, compact (Fig. 359), with mesothoracic spiracle hidden in slot between pronotum and lateral lobe of mesoscutum; prepectus small, subquadrate; flagellum with third anellus sometimes quadrate; metatibia with 2 apical spurs .... ***Dinarmus*** Thomson

Fauna: probably 3 spp., mainly *D. basalis* (Rondani). **Hosts**: Bruchidae, hence often in beans and grain stores.

– Propodeum longer and without or at most with very short, globose nucha (Figs. 488, 490), and if nucha relatively conspicuous then nucha far behind spiracles and median carina and plicae usually present (Fig. 491), the propodeal sculpturing often smooth or much less regular; mesosoma often longer; other characters also partly different 292

292(291) Gena with at least shallow depression at mouth corner; lower face with very short, inconspicuous setae; clypeal margin at least slightly emarginate; propodeum with broadly cordiform, weakly sculptured, median area delimited by distinct plicae, and with weak median carina but without trace of costula (Fig. 487); head very transverse, at least 1.45 times as broad as short pronotum, the pronotum much narrower than mesoscutum; stigmal vein more or less capitate (Fig. 360) .... ***Pseudocatolaccus*** Masi (part)

Fauna: 1 sp., *P. guizoti* (Girault) (= *P. americanus* Gahan; see Grissell 1985). **Hosts**: galls of *Asphondylia* (Cecidomyiidae) on various herbs.

– Gena convex or at most with narrow depression or groove along front part of mouth corner; lower face usually distinctly setose; clypeal margin different; propodeum different, either without complete plicae or with costula; head less transverse; pronotum larger, usually almost as broad as mesoscutum; stigmal vein hardly capitate 293

293(292) Metatibia with 2 apical spurs (Fig. 357); mesosoma convex, only rarely with mesoscutum slightly depressed (*Mazinawa*) 294

– Metatibia with 1 apical spur (outer spur absent); mesosoma convex or depressed 297

294(293) *Female* (male unknown): clava with long, narrow micropilose strip and claval sutures strongly oblique (Fig. 358); metacoxa unusually short and broad (Fig. 357); propodeum half as long as scutellum, medially flat, and with strong reticulation; gaster laterally with conspicuous, partly curved setae (Fig. 357) .... ***Mazinawa*** Bouček

Fauna: 1 sp., *M. laticoxa* Bouček (1993*b*), in Canada (ON).

– Clava without micropilose strip; metacoxa narrower; propodeum mostly longer; gaster laterally often not as setose 295

295(294) Gt_1 with posterior margin broadly emarginate (Fig. 354), medially less than half as long as broad; head and thorax with conspicuous, white, flattened setae; clypeal margin with deep median incision; propodeum reticulate, in median part with indication of transverse crest. *Female*: antenna short, flagellum clavate (Fig. 353) .... ***Nadelaia*** Bouček, see 284

– Gt_1 normal, with posterior margin straight or slightly produced medially; head and thorax without very conspicuous setae; clypeal margin usually different; propodeum without transverse median crest (Figs. 488, 489). *Female*: flagellum filiform or clavate 296

296(295) Gt_1 with posterior margin subangularly or arcuately produced (Fig. 361), in air-dried specimens Gt_1 often collapsed and strongly narrowed due to loose attachment laterally to Gt_2; lower face, just below toruli, slightly protuberant and shinier medially than elsewhere; clypeal margin very shallowly emarginate; pronotum with rounded margin; propodeum with short but distinct, rather weakly convex, smooth nucha (Fig. 488), with median carina developed only anteriorly, without plicae, and with short plical foveae; body usually less than 3 mm long.... .... ***Anisopteromalus*** Ruschka (part)[1]

Fauna/Hosts: probably 2 spp., mainly the cosmopolitan *A. calandrae* (Howard) on Coleoptera in stored grain, especially *Sitophilus* (Curculionidae).

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[1] After this key was completed one species of *Stenoselma* Delucchi was found in USA(CA); *Stenoselma* is nearly identical to *Anisopteromalus* except the forewing is completely setose dorsally.

– Gt$_1$ with posterior margin medially subtruncate to subemarginate, the tergum always very broad (Fig. 368); lower face below toruli not protuberant; clypeal margin medially often deeply excised, bidentate; pronotum with abrupt margin; propodeum medially subhorizontal, flat and without convex nucha, with or without median carina, but strongly reticulate between plical foveae, the fovea delimited outside by diverging plical strip (Fig. 489); body usually more than 3 mm long .... ***Oxysychus*** Delucchi

Fauna/Hosts: at least 3 spp., one on *Pissodes strobi* (Peck) (Curculionidae) and two on *Acanthocinus* and *Calidium* (Cerambycidae).

297(293) Mesosoma normally or moderately convex, not evidently flattened, with scutellum at least moderately convex (Figs. 491, 492, 493); torulus at or above lower margin of eye 298

– Mesosoma distinctly flattened (Figs. 373, 376), with scutellum flat or almost flat, or if mesosoma only moderately depressed then torulus below lower margin of eye (*Psilonotus*) 307

298(297) Gaster with cercus having one seta more than twice as long as the other setae (Fig. 367); lower face convex, malar space only slightly more than one-quarter length of eye; clypeal margin with deep median incision (Fig. 366); propodeum short, with shiny cordiform area divided by median carina, and with strong, sinuate plicae ending at raised crescentic adpetiolar strip (strip at dorsal margin of propodeal foramen); mesoscutal shoulders extending laterally beyond narrow pronotum; pronotum with neck subconical and collar linear .... ***Oaxa*** Bouček

Fauna: 1 sp., *O. albiclava* Bouček (1993*b*), in Mexico (Oaxaca).

– Gaster with cercus having at least the 3 longest setae about equal in length; lower face not prominent, malar space in most species longer; other characters also different 299

299(298) Torulus above convex middle of face (Fig. 363), about twice as far from truncate clypeal margin as from anterior ocellus; pronotum in dorsal view with sides almost parallel and in lateral view each lateral panel with impressed groove parallel to posterior margin; prepectus high but very short and mostly concealed; mesoscutum (Fig. 364) medially with meshes of reticulation very broad and their transverse septa unusually raised so that surface of mesoscutum appearing rasp-like, especially in lateral view. [*Male*: antenna Fig. 363.] .... ***Raspela*** Bouček

Fauna: 1 sp., *R. celtidis* Boucek (1993*b*), in USA (TX). **Hosts**: stem galls on *Celtis*.

– Torulus closer to middle of face; pronotum with lateral panel different, with broad groove oblique at least in upper part; mesoscutum with meshes of reticulation not unusually large and not appearing rasp-like 300

300(299) Pronotal collar with distinctly raised margin; thoracic setae not conspicuous; propodeum more than half as long as scutellum, with irregular reticulation and some rugae, with plicae present but obliterated in anterior half, with median carina incomplete, and with adpetiolar margin distinctly raised. [Antenna, see Fig. 356.] .... ***Holcaeus*** (***Cricellius*** Thomson) (part)

Fauna: at least 2 spp. in USA (middle and eastern states).

– Pronotal collar with abruptly angled or rounded margin (Figs. 491, 492, 493); thorax with conspicuous setae; propodeum less than half as long as scutellum (Fig. 491), with plicae indicated by foveae but mostly indistinct, and with adpetiolar margin rarely raised 301

301(300) Gt_1 with posterior margin angularly produced (Fig. 361); thoracic dorsum, including scutellum, with abundant dark setae .... ***Anisopteromalus*** Ruschka, see 296

– Gt_1 with posterior margin not angularly produced; thoracic dorsum with dark or white, often conspicuous setae 302

302(301) Torulus close to middle of face 303

– Torulus distinctly below middle of face (as Fig. 369) 304

303(302) Forewing with speculum extending behind marginal vein to stigmal vein and revealing 1 or 2 rows of mostly conspicuous admarginal setae on ventral surface (Figs. 349, 350); face, temple, and thorax often with white setae, the setae sometimes broadened or even flat-fusiform (as in Fig. 491). [Propodeum with nucha rounded, triangular, flattened posterodorsally (Fig. 490).] .... ***Lyrcus*** Walker (part)

Fauna: over 15 spp., the number increasing toward Mexico. **Hosts**: Cecidomyiidae, Bruchidae, and Curculionidae.

– Forewing with speculum reduced, the setae extending broadly along marginal vein and over ventral surface (hence without evident narrow strip or line of admarginal setae); body with unmodified setae 304

304(303) Head in anterior view rather strongly transverse, longest diameter of eye much shorter than width of upper face (Fig. 369); profemur and metafemur moderately thickened; pronotal collar short, dorsally rounded. *Female*: hypopygium almost reaching apex of gaster (Fig. 300), the hypopygial apex broadly rounded .... ***Tomicobia*** Ashmead, see 248

– Head in anterior view less strongly transverse, longest diameter of eye at most moderately shorter than width of upper face; femora generally slender; pronotal collar usually longer. *Female*: hypopygium not reaching apex of gaster, the hypopygial apex more or less pointed 305

305(304) *Male only*: pronotal margin fine, but at least medially distinctly raised, carinate .... ***Psilonotus*** (Walker), see 308

– *Both sexes*: pronotal margin not distinctly raised although often quite abruptly angular 306

306(305) Pronotal collar medially very short, for the most part a shiny strip (Fig. 492); mesoscutum with irregular reticulation because of intermixed shallow setiferous punctures; mandibles each with 4 teeth; flagellum with 3 strongly transverse anelli (Fig. 375); ocelli very small; propodeal spiracle short-ovate, its longest diameter one-fifth length of propodeum. *Male*: head with curved smooth strips (Fig. 289) .... ***Meraporus*** Walker (part)

Fauna: 1 Holarctic sp., *M. graminicola* Walker. **Hosts**: *Mayetiola* (Cecidomyiidae) in grass stems.

– Pronotal collar short or longer, but mostly without conspicuous smooth strip (Fig. 493) **or** body with following features: mesoscutal reticulation regular, usually without distinct setiferous punctures; left mandible with 3 teeth; flagellum with third anellus often only slightly transverse, or quadrate, or even oblong (Fig. 325); ocelli not very small; propodeal spiracle ovate, its longest diameter one-third to one-quarter length of propodeum. *Male*: head without curved smooth strips .... ***Mesopolobus*** Westwood (part)

Fauna: several dozen spp. **Hosts**: mostly in galls of Cynipidae, cocoons of various Lepidoptera, Symphyta, and Coleoptera, and rarely on other hosts.

307(297) Propodeal spiracle separated from metanotal margin by at least twice the longest diameter of spiracle; postmarginal vein only slightly longer than stigmal vein (Fig. 373); scape slightly clavate .... ***Zdenekiana*** Huggert (part)

Fauna: 1 sp., *Z. squama* Huggert (1976), in Canada (PQ).

– Propodeal spiracle closer to metanotal margin; postmarginal vein considerably longer than stigmal vein; scape not clavate 308

308(307) Pronotal collar with carinate margin. *Female*: mesosoma dorsally depressed and shiny, with reticulation extensively obliterated. *Female*: gaster more or less compressed laterally and hypopygium extending almost to apex (Fig. 376) .... ***Psilonotus*** Walker (part)

Fauna: at least 2 Holarctic spp. **Hosts**: galls of *Semudobia* (Cecidomyiidae) in catkins of *Betula*.

– Collar not carinate but sometimes with distinct step-like edge; mesosoma dorsally only moderately shiny, with reticulation always present although often superficial, engraved, particularly on scutellum; body, including gaster, depressed dorsally, sometimes extremely so. *Female*: hypopygium not extending to near apex .... ***Anogmus*** Förster

Fauna: at least 5 spp. **Hosts**: associated with Cecidomyiidae in cones of conifers, particularly *Picea* and *Abies*.

309(70) Flagellum with 3 short anelli and 5 funicular segments; propodeum medially less than half as long as scutellum, without produced nucha, and with sharp posterolateral corners; occiput without transverse carina or fold 310

– Flagellum with 2 anelli and 6 funicular segments; propodeum medially more than half as long as scutellum, posteriorly narrowed into a slight or distinct nucha, and with posterolateral corners not sharp; occiput in most species with distinct though blunt, transverse fold 311

310(309) Pronotum reduced dorsally, steep, without subhorizontal collar; thoracic dorsum dull, with dense reticulation and without distinct punctures; propodeum with submedian areas finely sculptured, median carina shorter than flat adpetiolar triangle, and plicae strongly converging; wing stumps truncate apically; eye nearly touching occipital cavity posterodorsally; gaster with cercus having 1 very long, curved seta .... ***Lariophagus*** Crawford, see 232

Note: 1 undescribed, short-winged sp. in USA (TX).

– Pronotum with distinct collar having smooth dorsal strip; thoracic dorsum (and head) fairly shiny, with distinct setiferous punctures; propodeum submedially with coarse rugae, with median carina longer than adpetiolar strip, and with plicae curved but anteriorly almost parallel; wing stumps acuminate (Fig. 374); eye not close to occipital cavity; gaster with cercus having short setae only .... ***Meraporus*** Walker, see 306

311(309) *Male only*: wing stumps extending beyond posterior margin of Gt_1; thoracic dorsum shiny, with midlobe of mesoscutum having shallowly engraved reticulation (Fig. 451) .... ***Nasonia*** Ashmead, see 207

– *Both sexes*: wing stumps usually much shorter or much longer; thoracic dorsum less shiny, with distinct raised-reticulate sculpture (Fig. 453) .... ***Trichomalopsis*** Crawford, see 210

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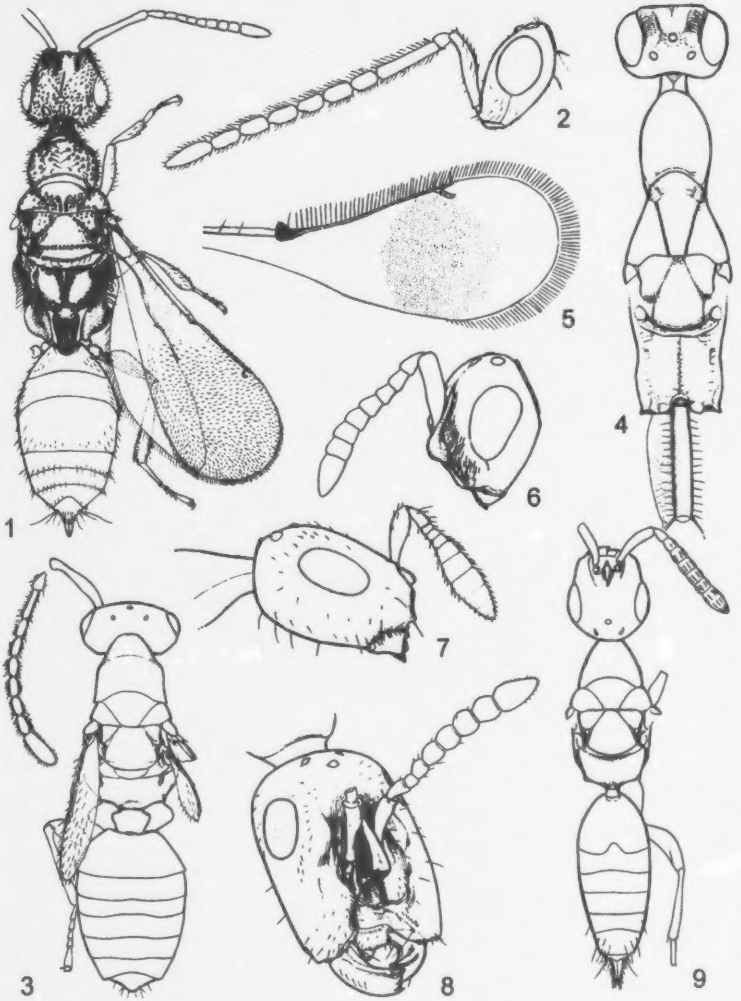

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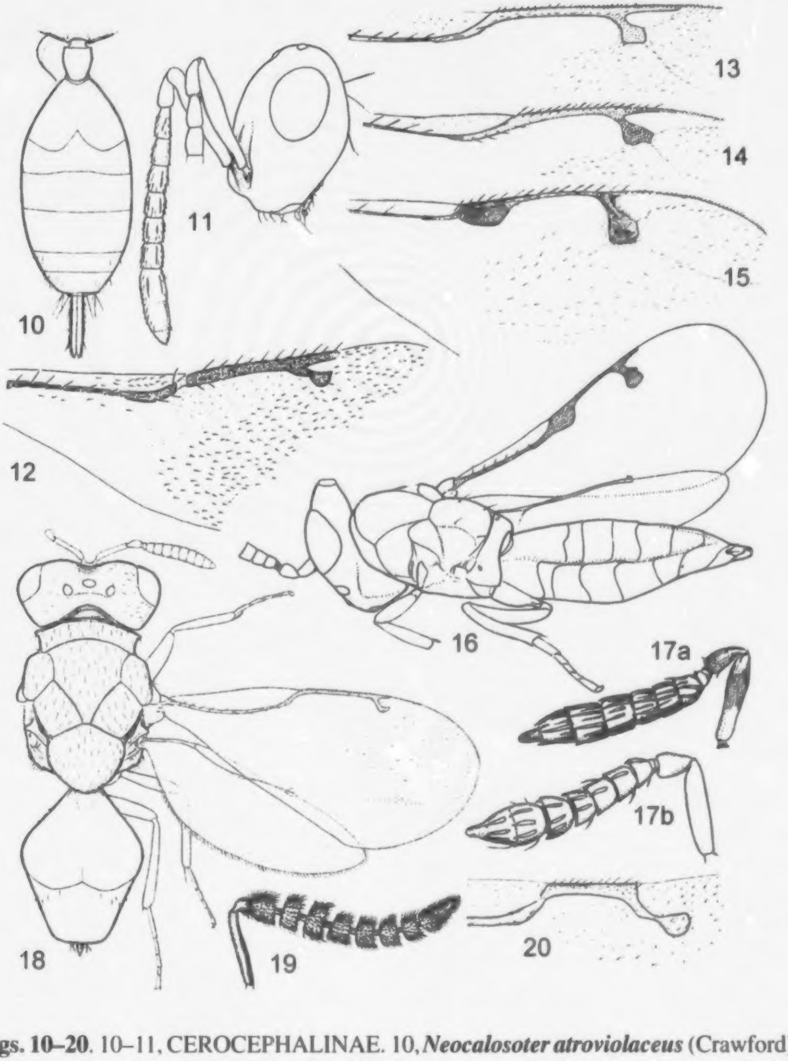

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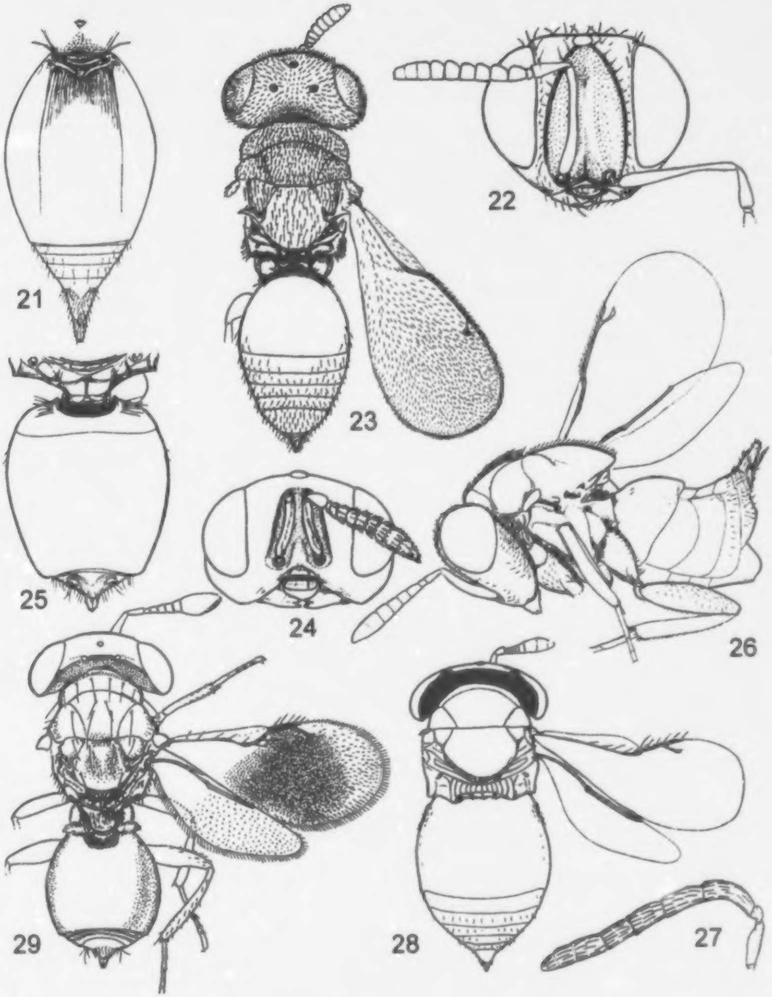

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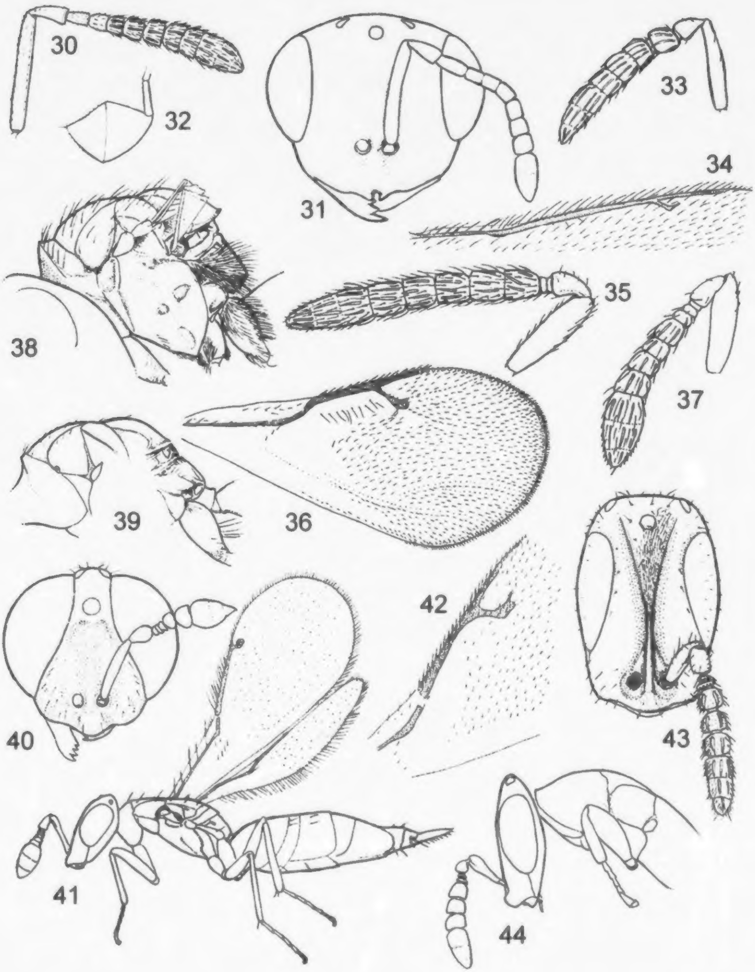

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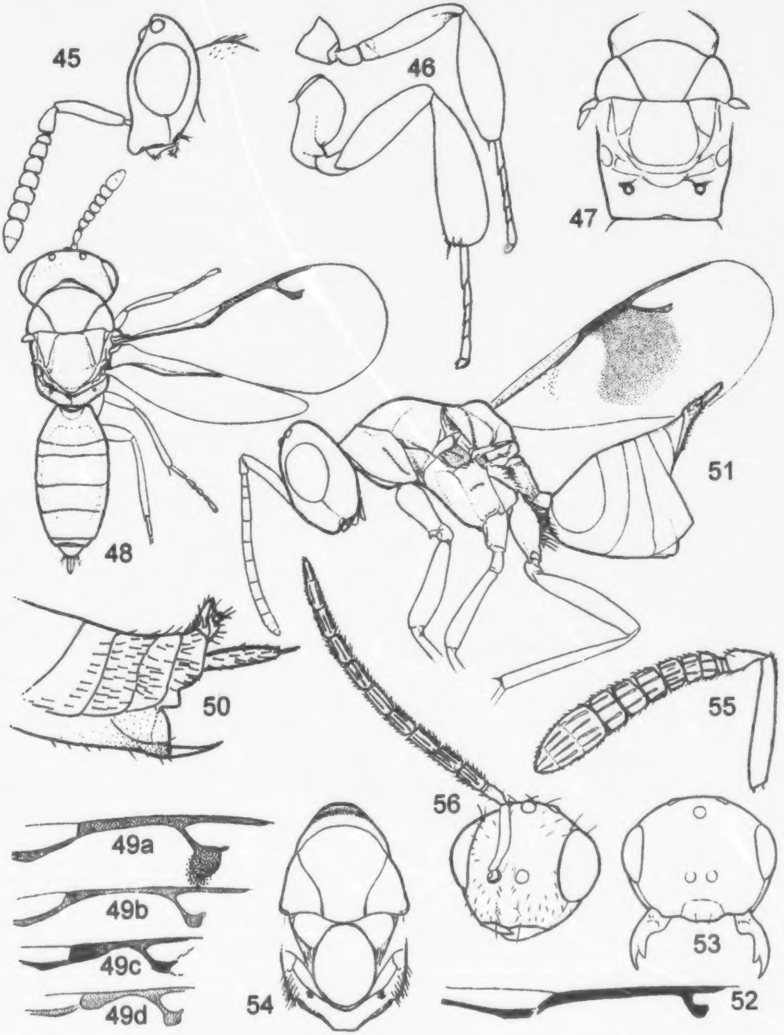

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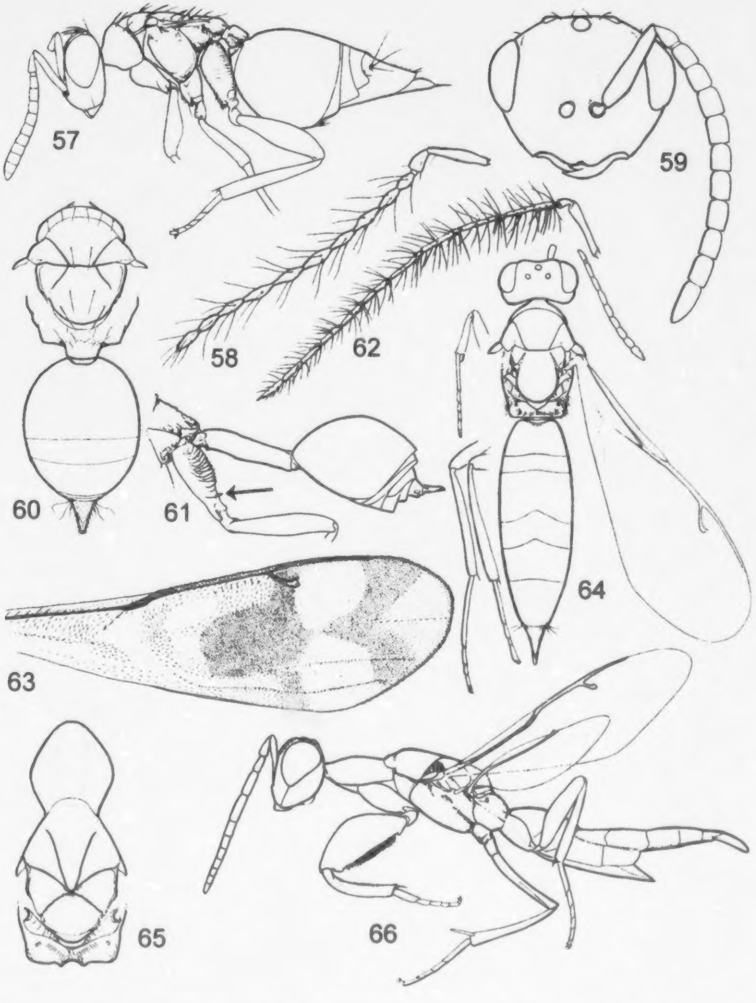

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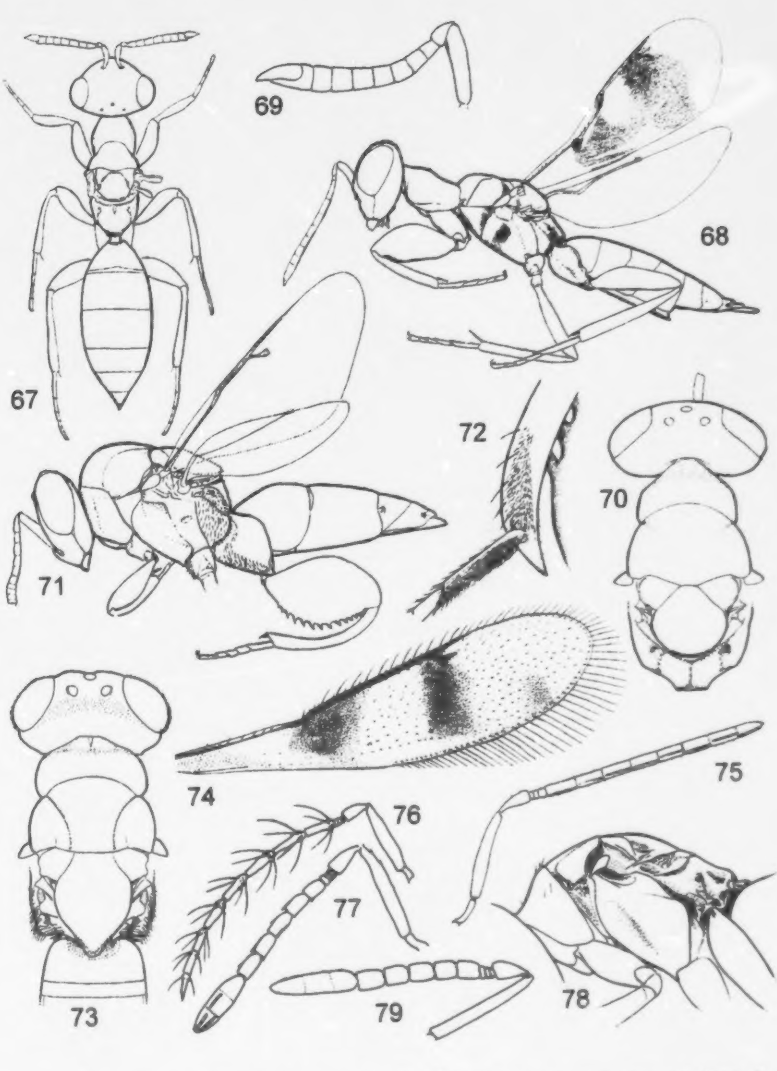

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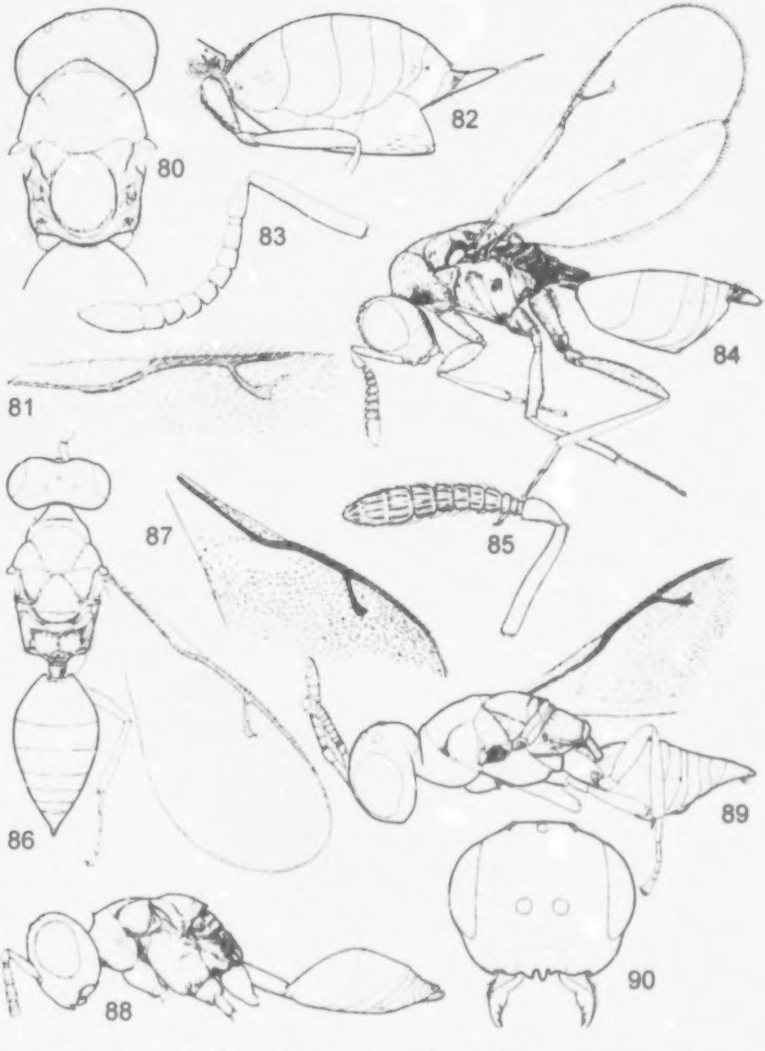

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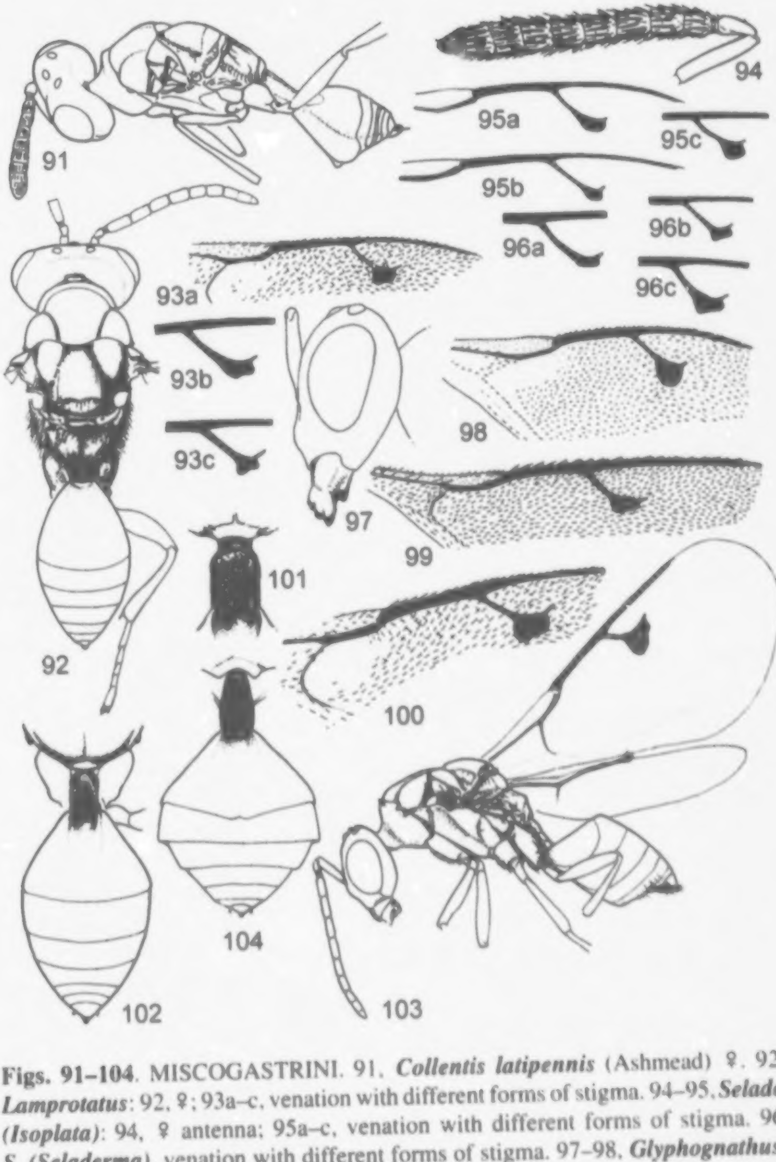
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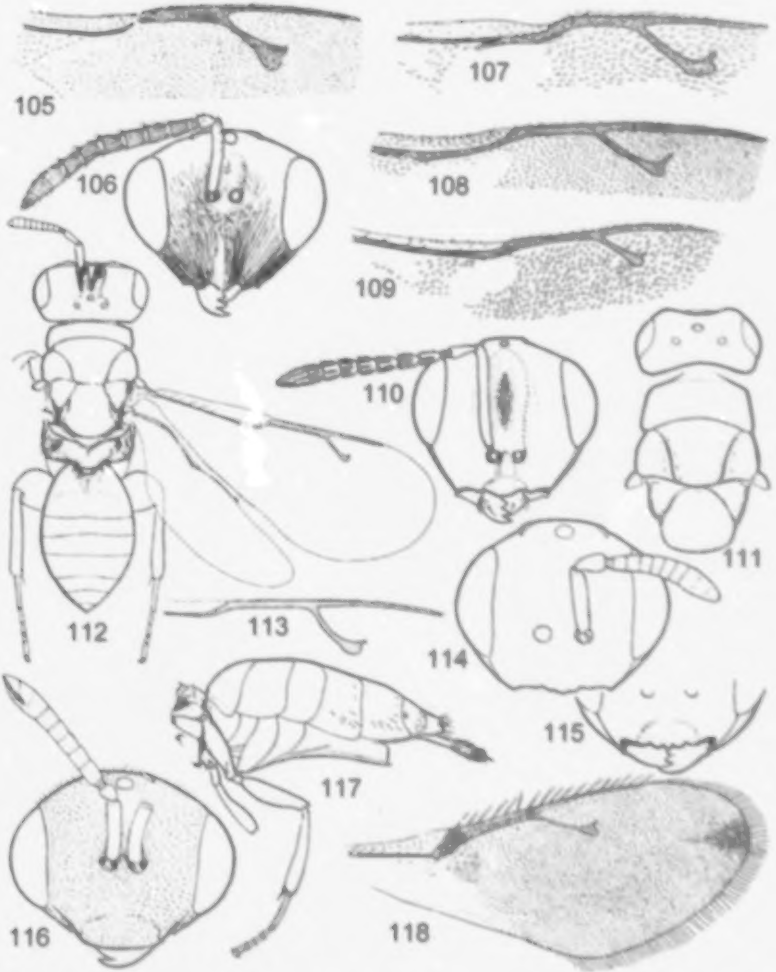

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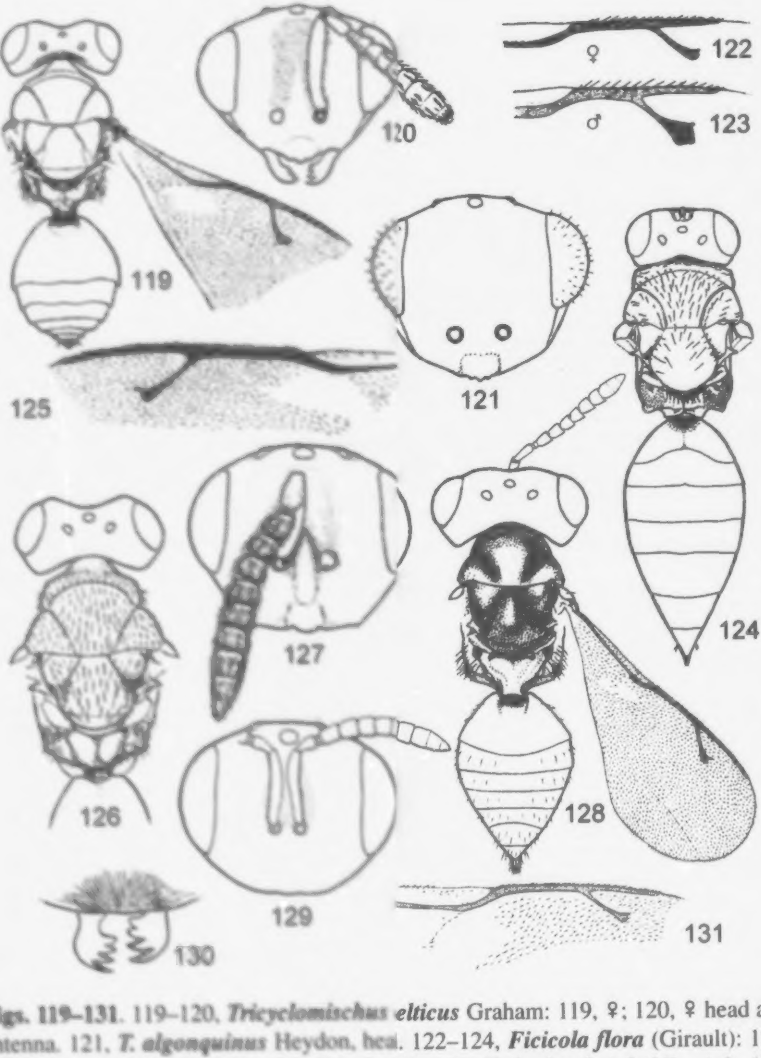
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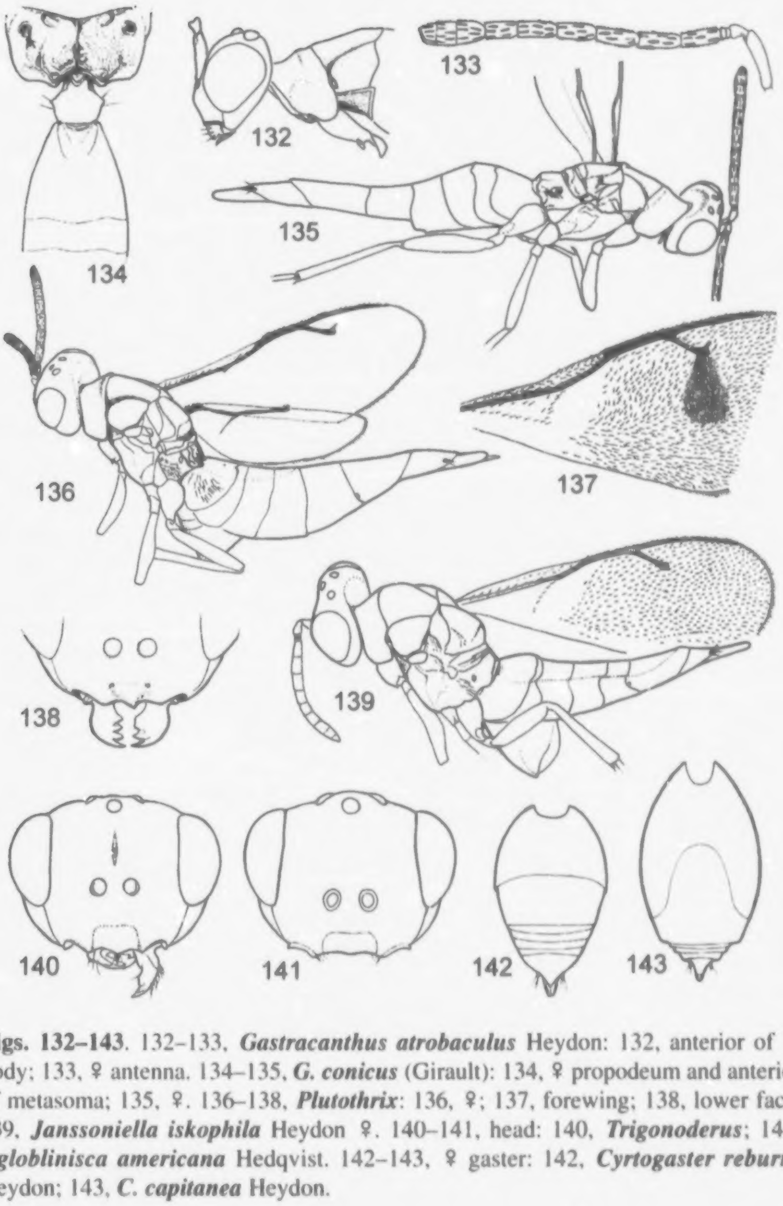

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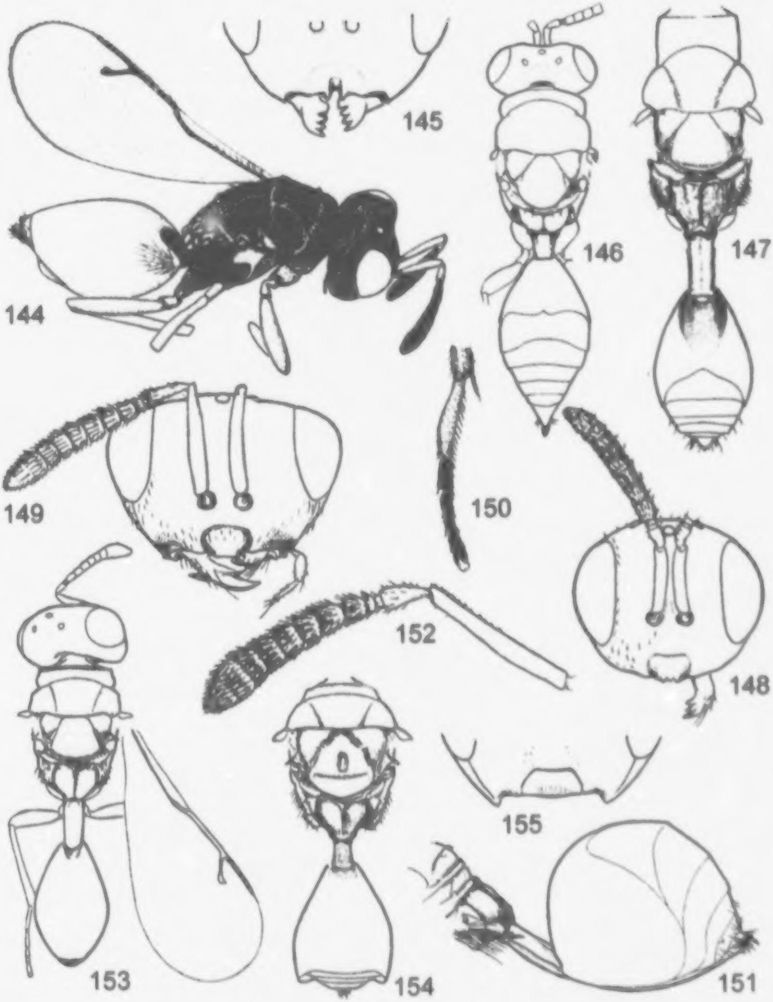

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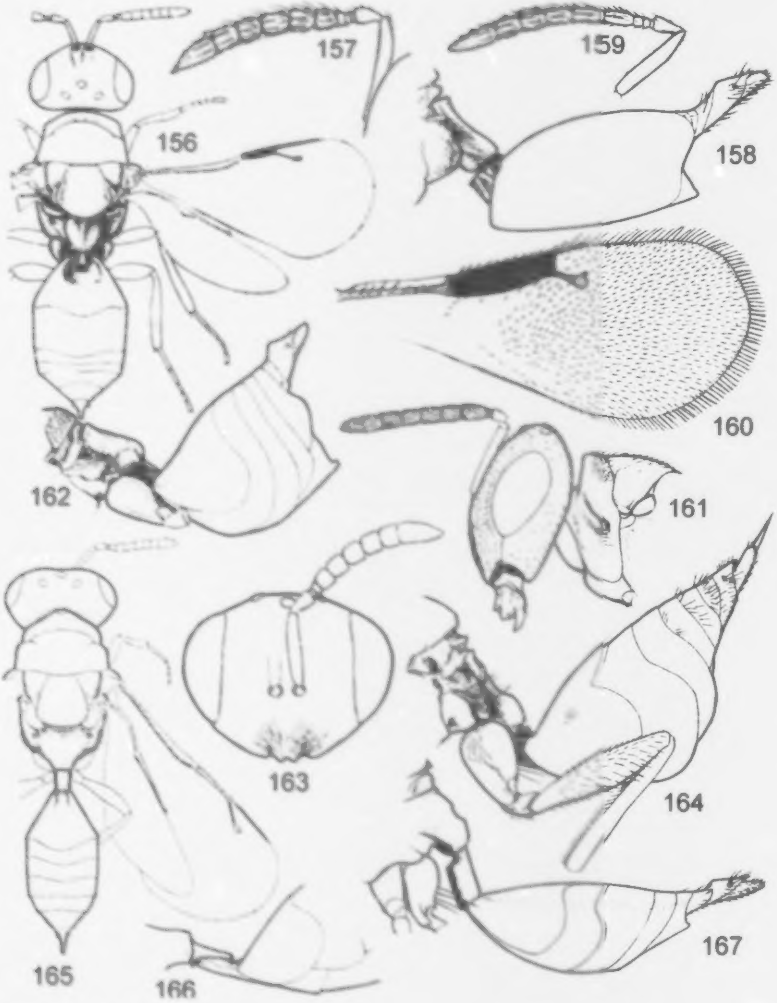

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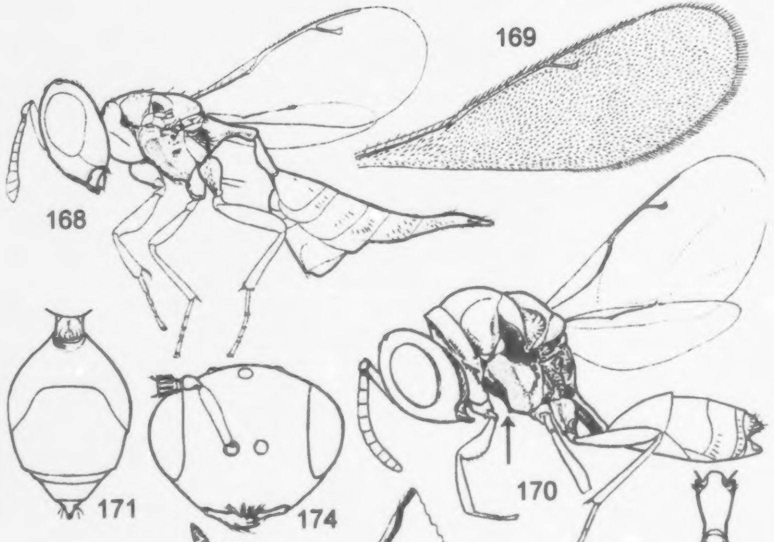

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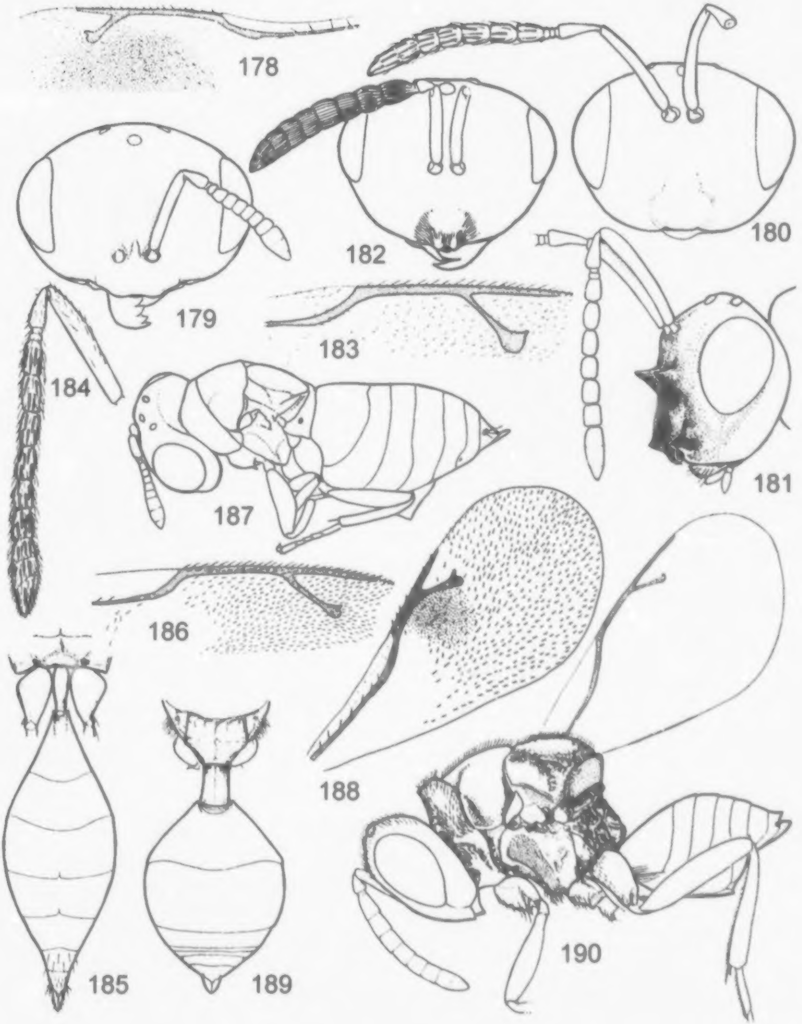

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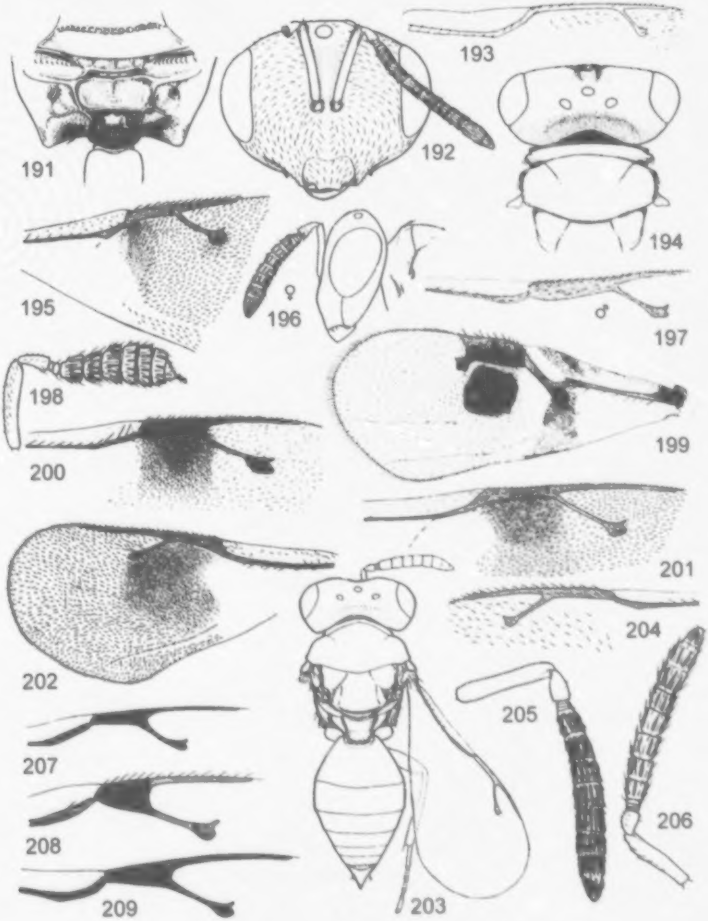

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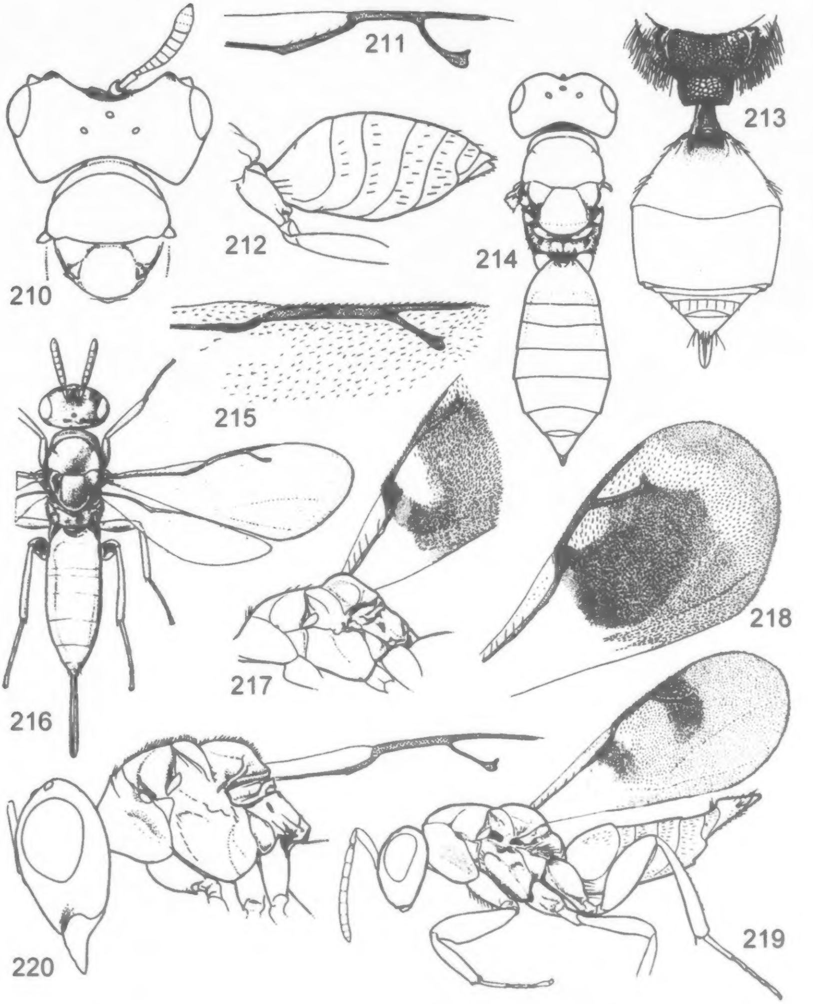

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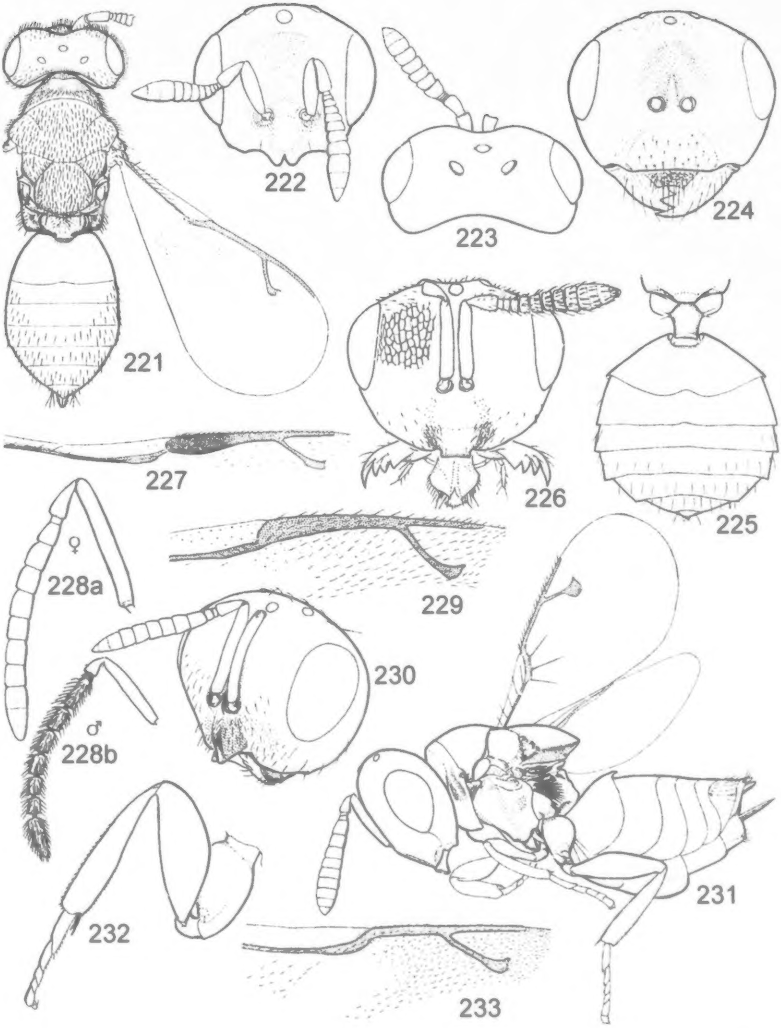
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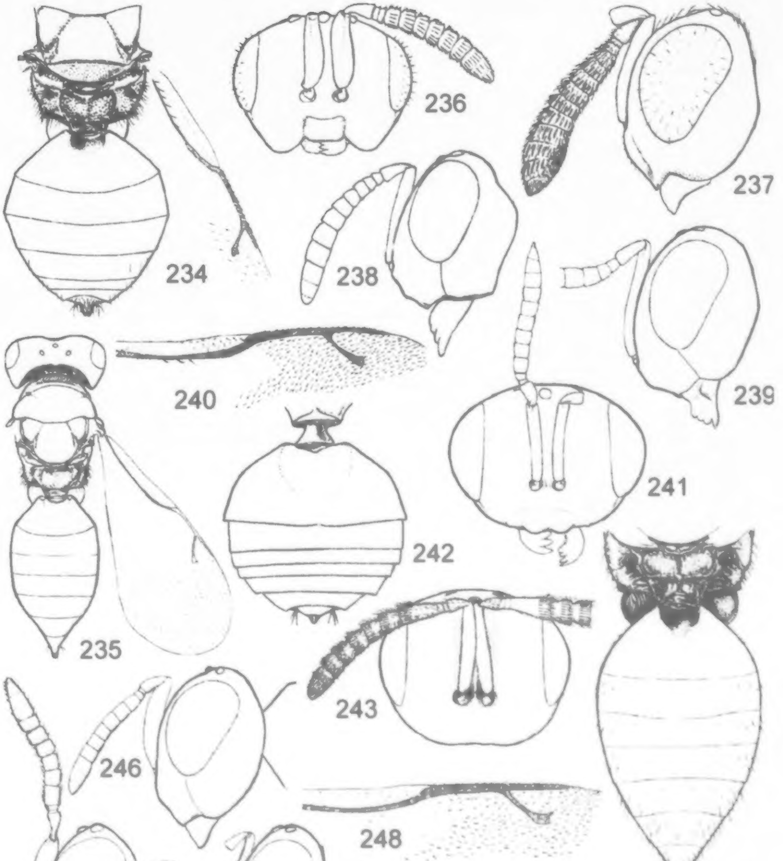
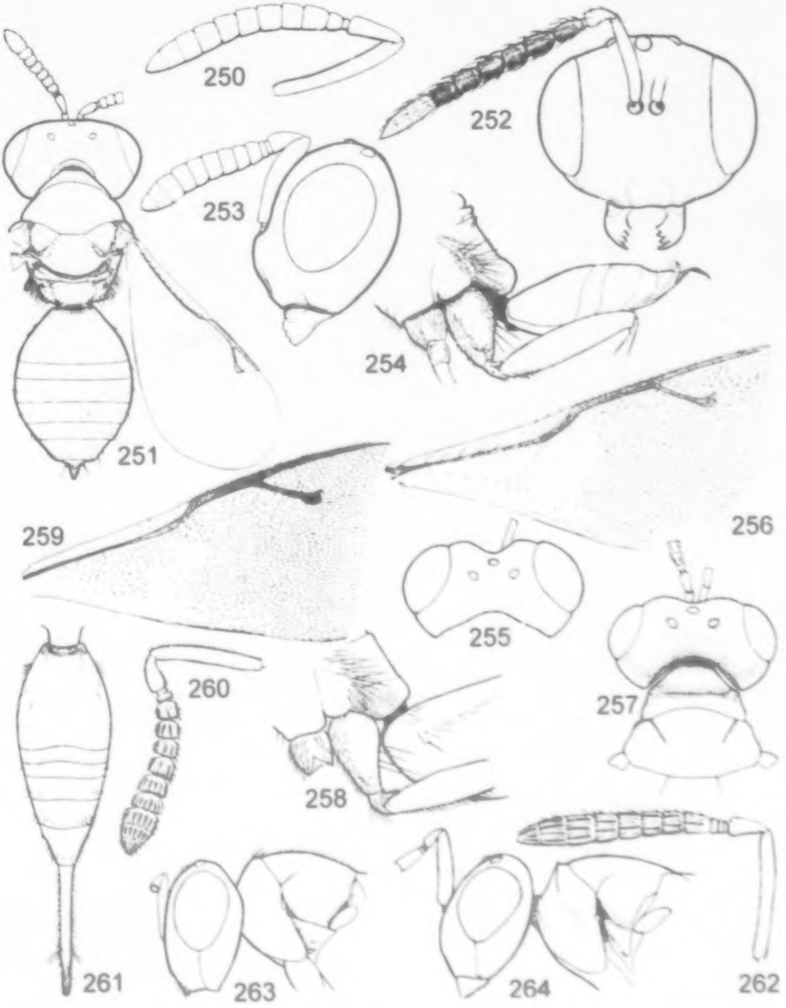
Figs. 221–233. 221–222, ***Grissellium hirtulum*** Bouček: 221, ♀; 222, ♀ head and antennae. 223, ***Habritys latrus*** Wallace, head and antenna. 224, ***H. brevicornis*** (Ratzeburg), head. 225–226, ***Kaleva microps*** Bouček: 225, metasoma; 226, head and appendages. 227–228a–b, ***Muscidifurax raptor*** Girault & Sanders: 227, ♀ venation; 228a, ♀ antenna; 228b, ♂ antenna. 229–230, ***Helocasis burksi*** Wallace: 229, venation; 230, ♀ head. 231, ***Meximalus heratyi*** Bouček ♀. 232–233, ***Ptinocida latipes*** Bouček: 232, hind leg; 233, venation.



Figs. 234–249. 234, ***Schizonotus sieboldi*** (Ratzeburg), posterior of body and venation. 235, ***Dibrachoides dynastes*** (Förster) ♀. 236–239, head and antenna: 236, ***Diglochis*** ♂; 237, ***Diglochis*** ♀; 238, ***Coelopisthia***, ♂; 239, ***Coelopisthia*** ♀ (from FL). 240–242, ***Cyclogastrella deplanata*** (Nees): 240, venation; 241, ♀ head and antenna; 242, ♀ metasoma. 243–244, ***Conomorium pelor*** Bouček ♀: 243, head and antenna; 244, propodeum and metasoma. 245–246, ***Tritneptis***, ♀ head. 247, ***Dibrachys***, head. 248, ***D. hians*** Bouček, venation. 249, ***Systellogaster ovivora*** Gahan; venation.



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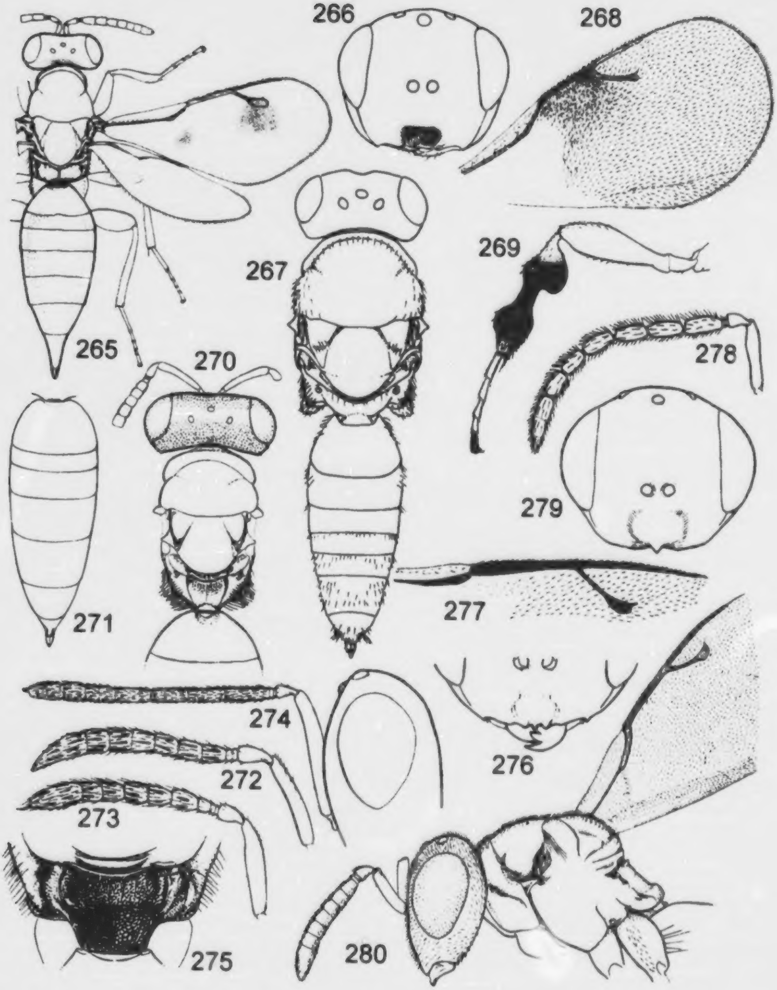
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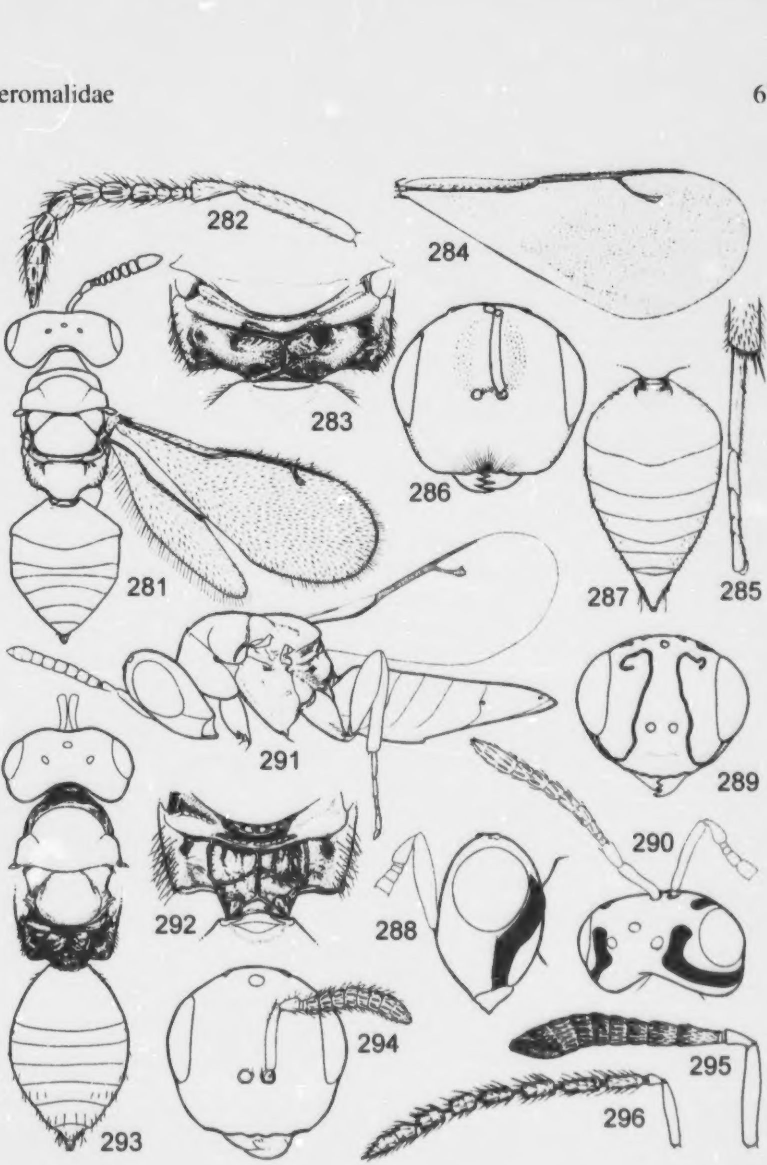
Figs. 265–280. 265, ***Rhopalicus tutela*** (Walker) ♀. 266–267, ***Quercanus luteogaster*** Heydon: 266, ♀ head; 267, ♀. 268–269, ***Spaniopus***: 268, ♀ forewing; 269, ♂ middle leg. 270, ***Peridesmia discus*** (Walker) ♀. 271, ***Merisus***, ♀ metasoma. 272–273, ***Homoporus***, ♀ antenna. 274, ***Norbanus***, ♀ head and antenna. 275, ***Ablaxia*** ♀ (from BC), propodeum. 276, ***Stenomalina***, lower face. 277–279, ***Hemitrichus seniculus*** (Nees): 277, venation; 278, ♂ antenna; 279, ♀ head. 280, ***Arachnopteromalus dasys*** Gordh, anterior of ♀ body and forewing.



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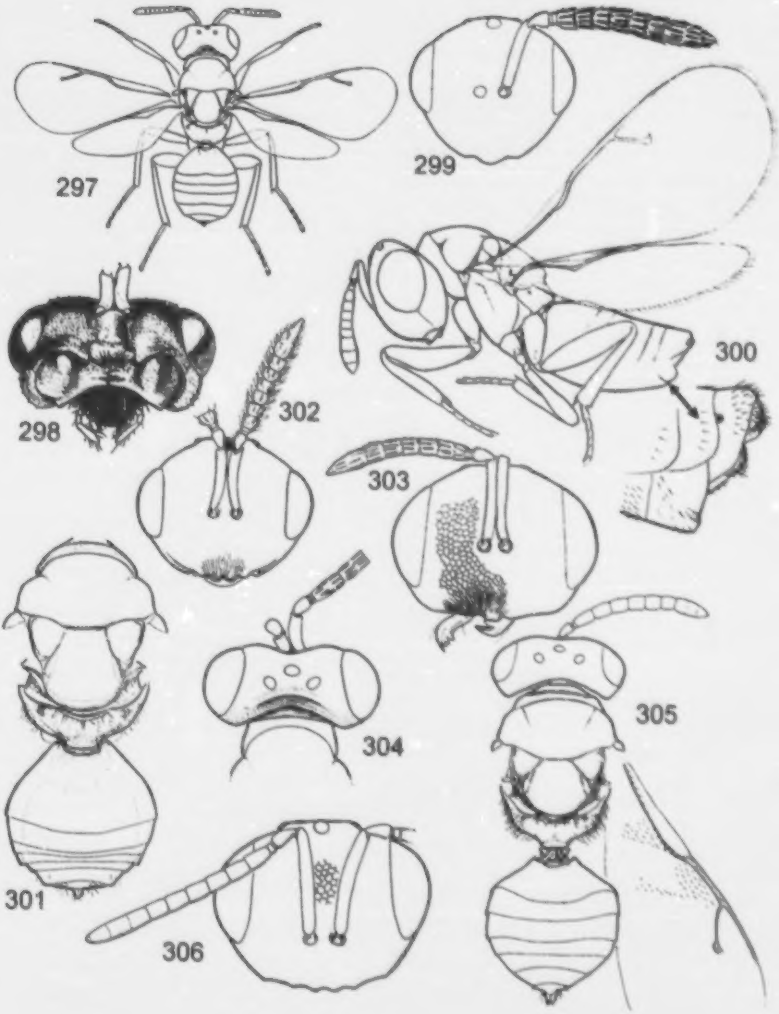

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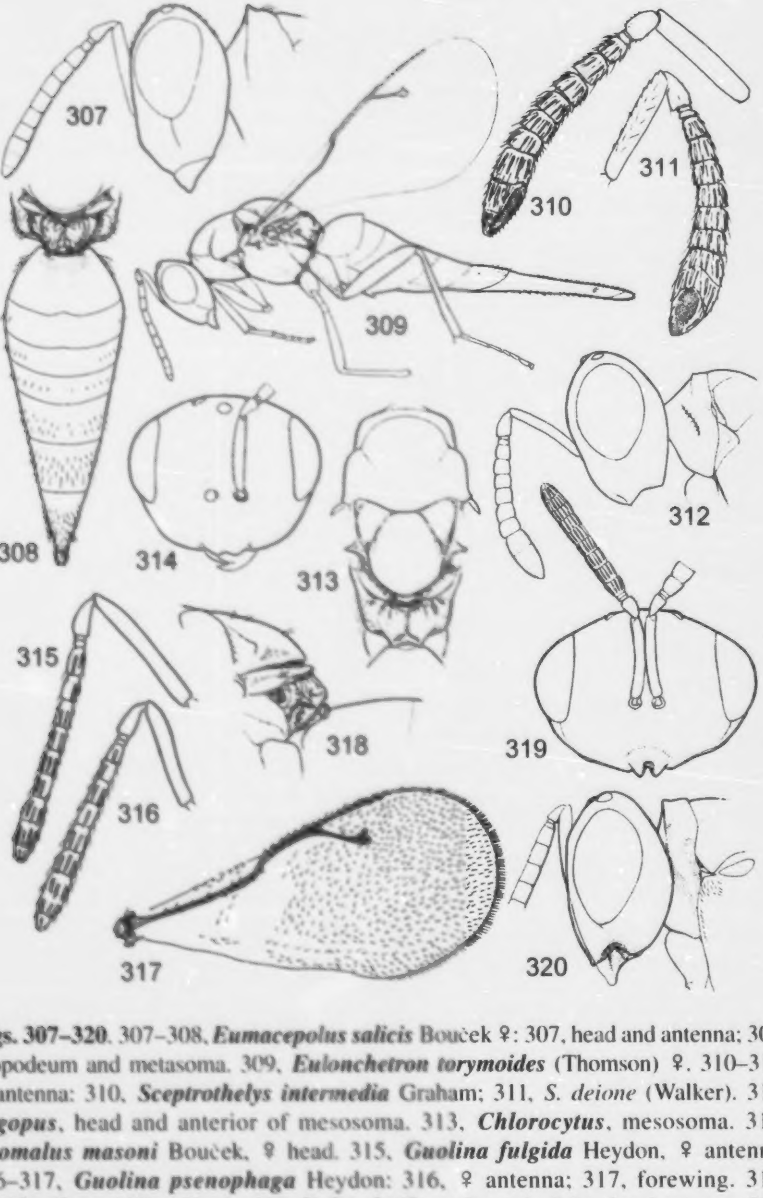

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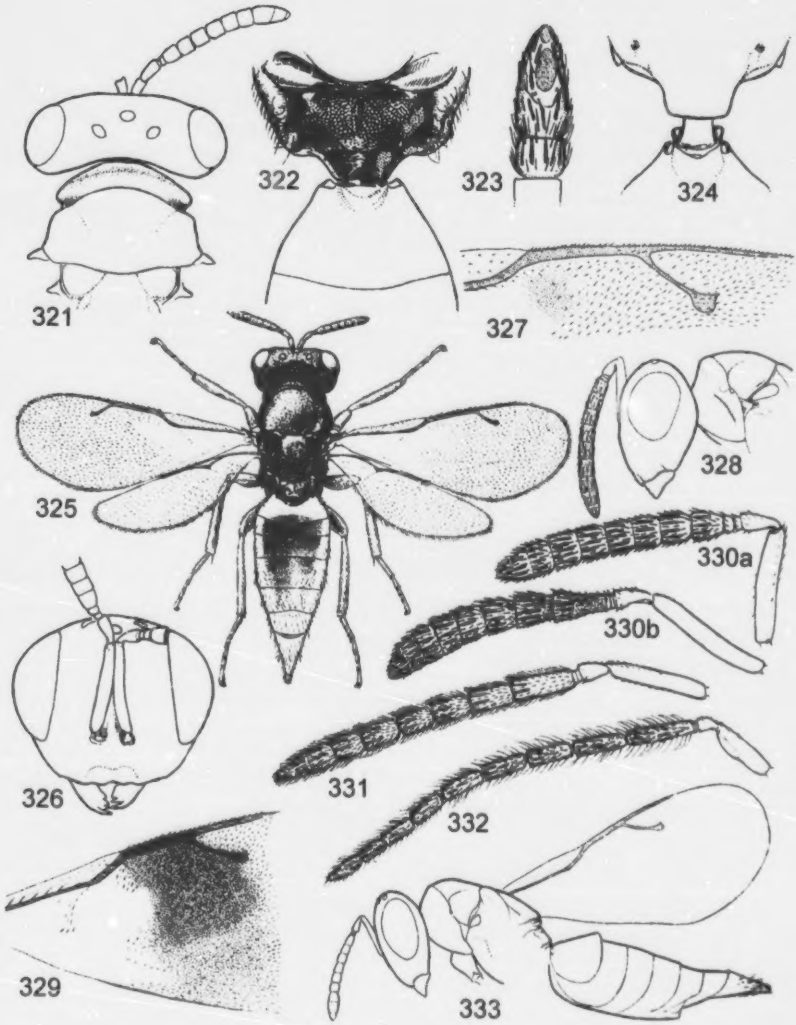
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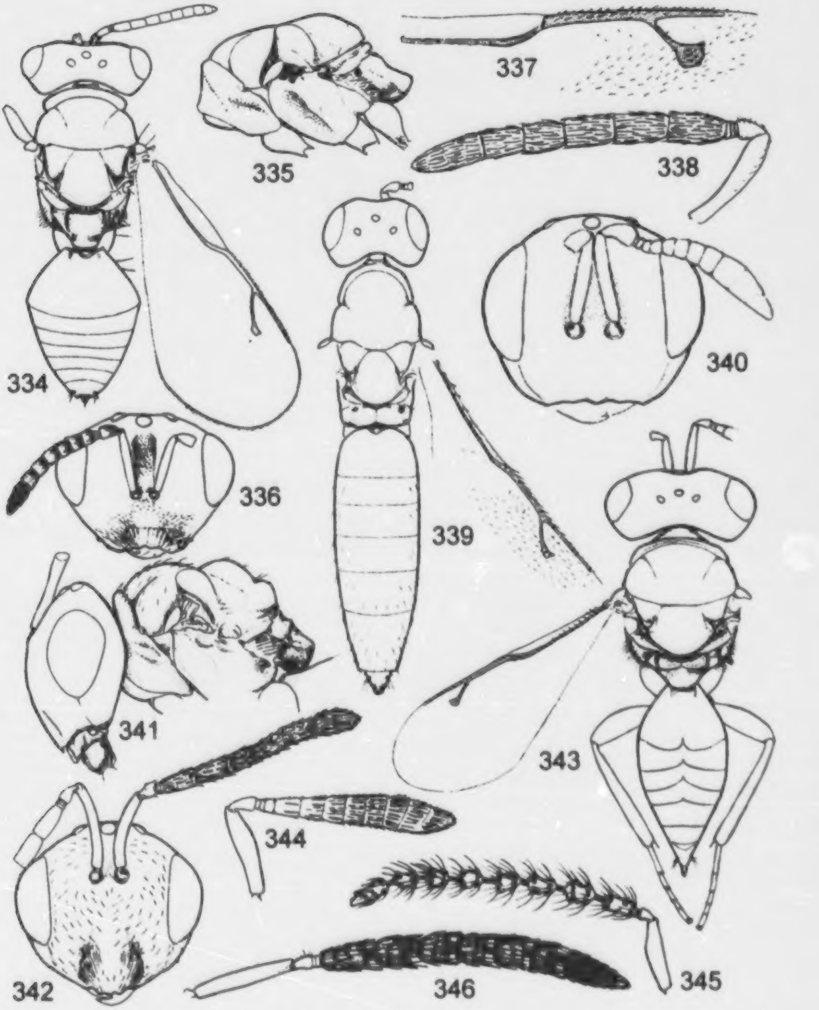
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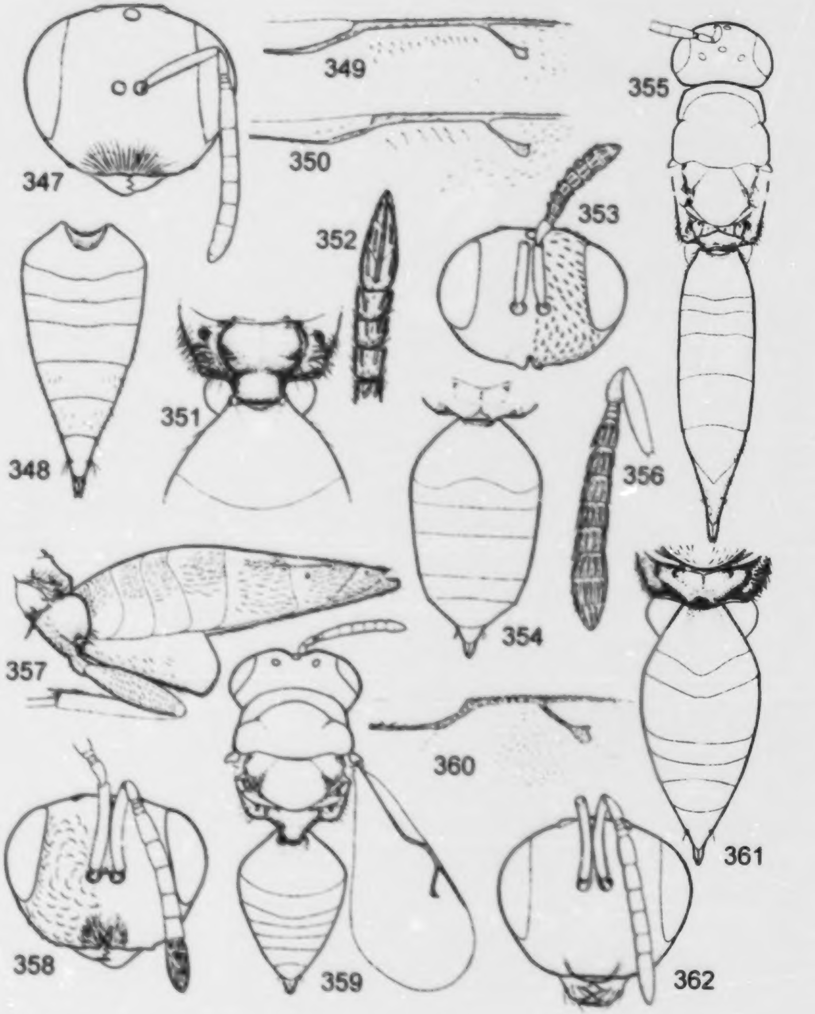

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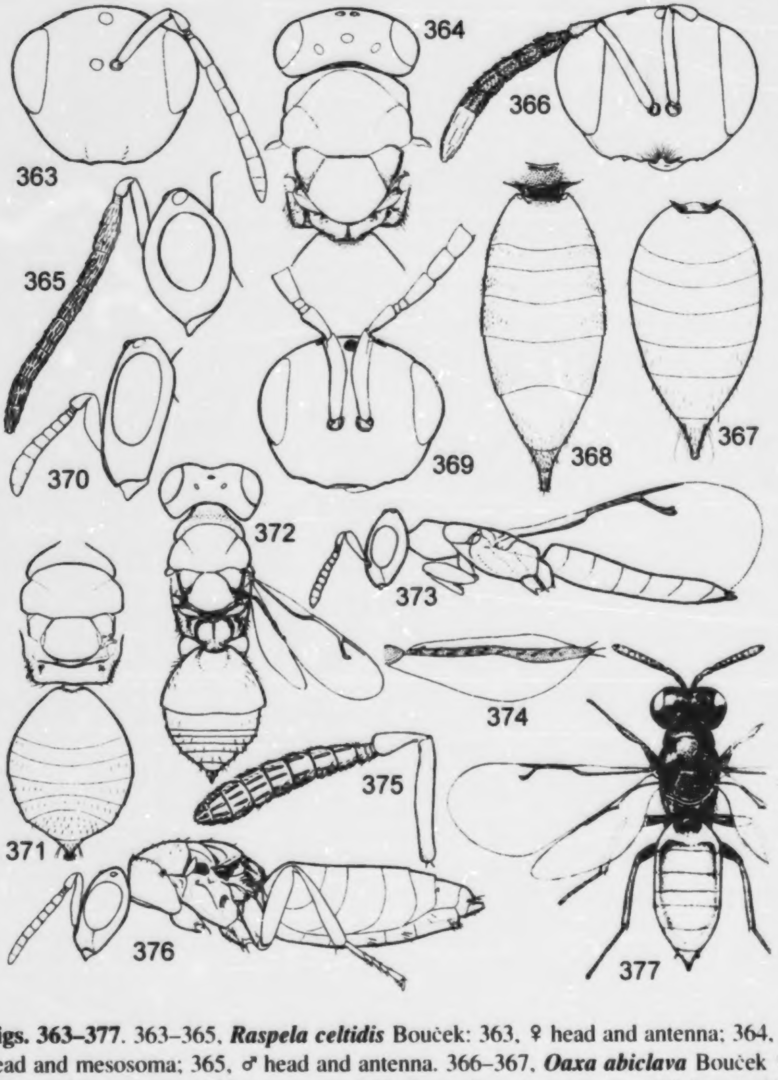

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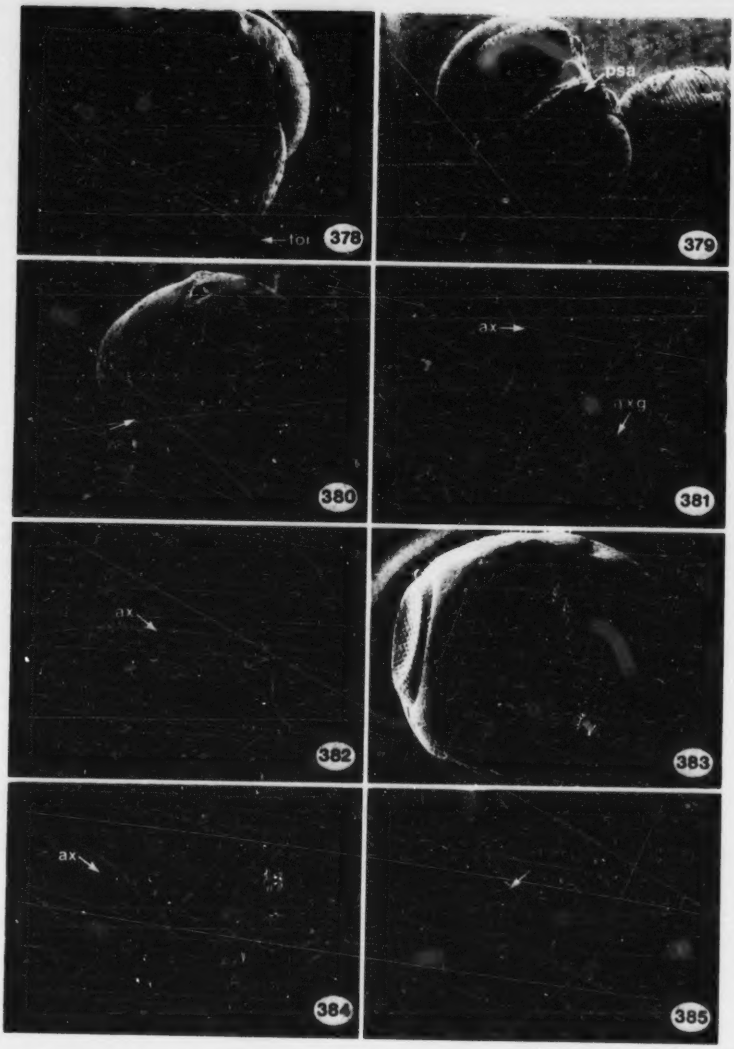
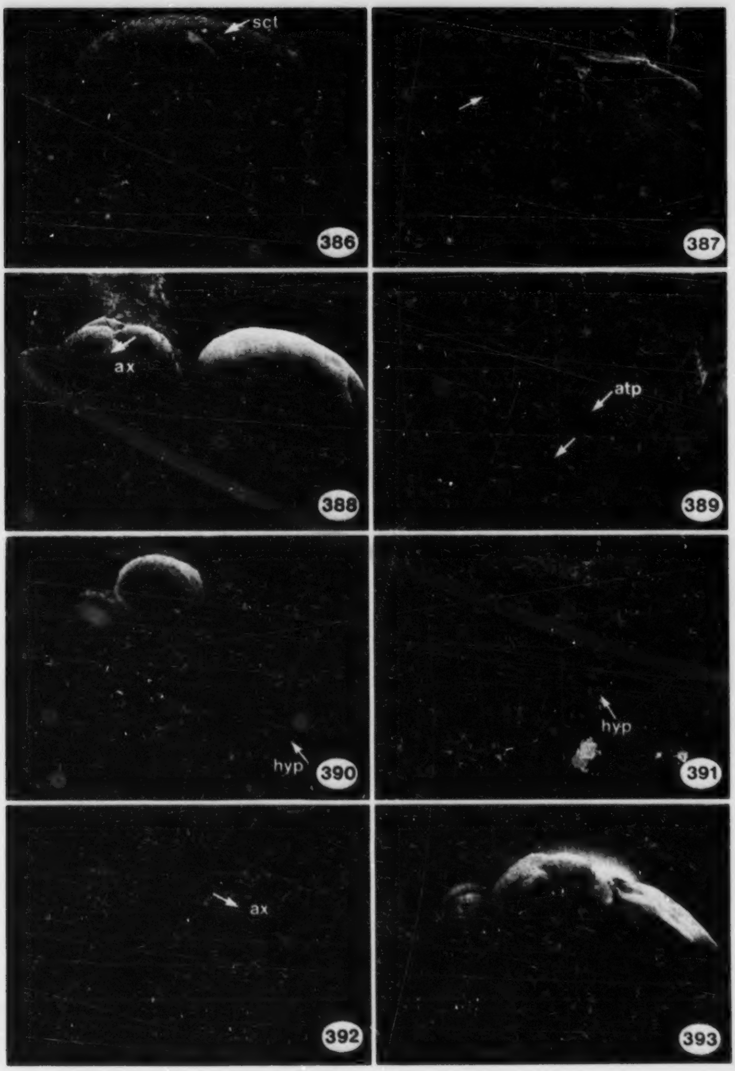


Figs. 378–385. 378, SPALANGIINAE, ***Spalangia endius*** Walker, ♀ head. 379, LEPTOFOENINAE, ***Leptofoenus rufus*** LaSalle, ♀ head. 380, CEROCEPHALINAE, ***Cerocephala rufa*** (Walker), ♀ head. 381–383, COLOTRECHNINAE. 381, ***Colotrechnus ignotus*** Burks, ♀ mesosoma. 382–383, ***Baridobius primulus*** Heydon ♀: 382, mesosoma; 383, head. 384, EUTRICHOSOMATINAE, ***Eutrichosoma mirabile*** Ashmead, ♀ mesosoma. 385, EROTOLEPSIINAE, ***Erotolepsia***, ♀ propodeum and metasoma.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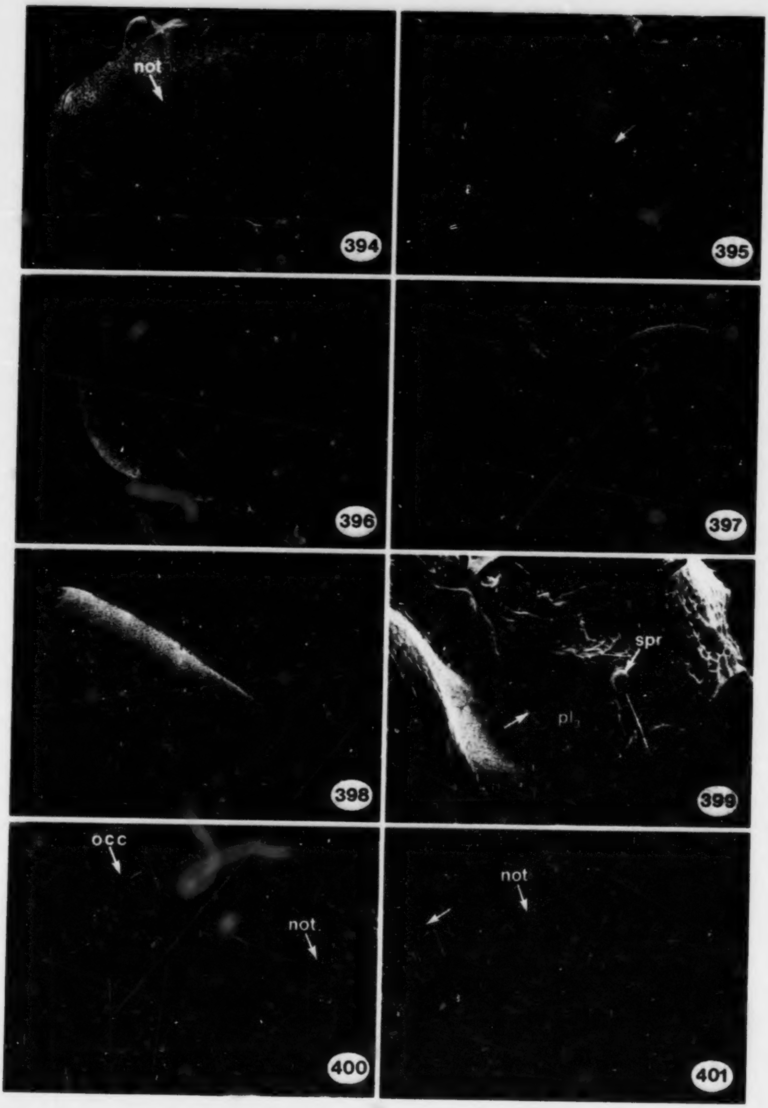
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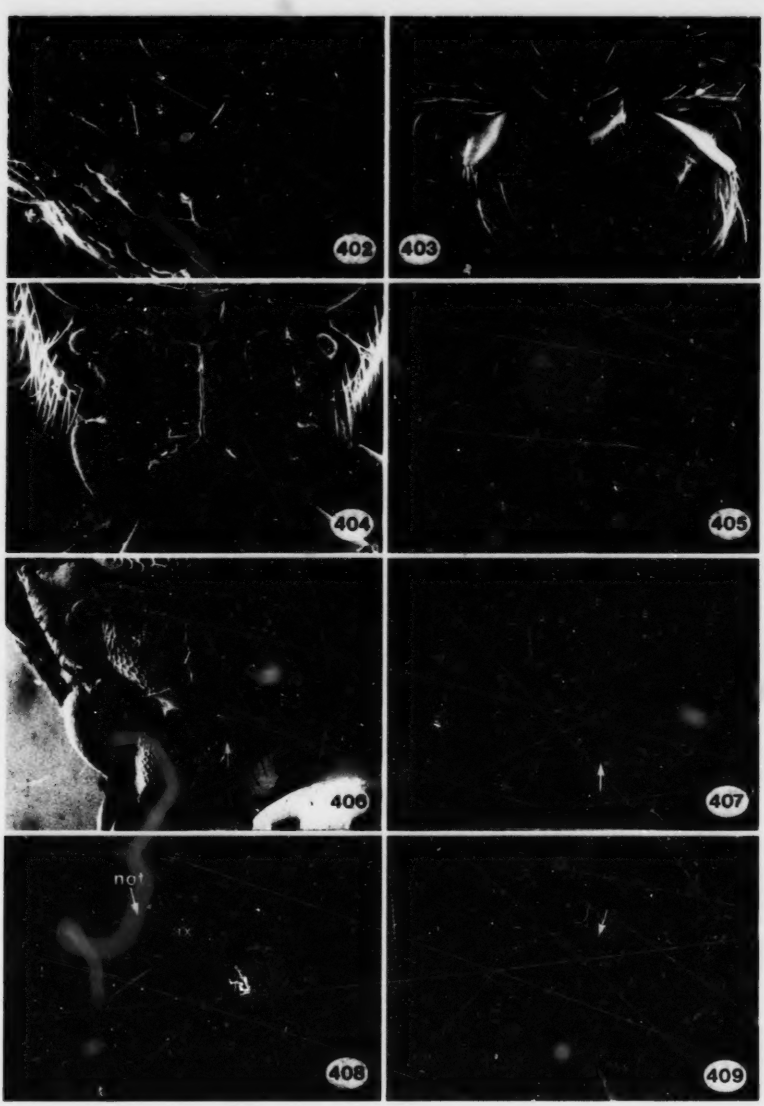
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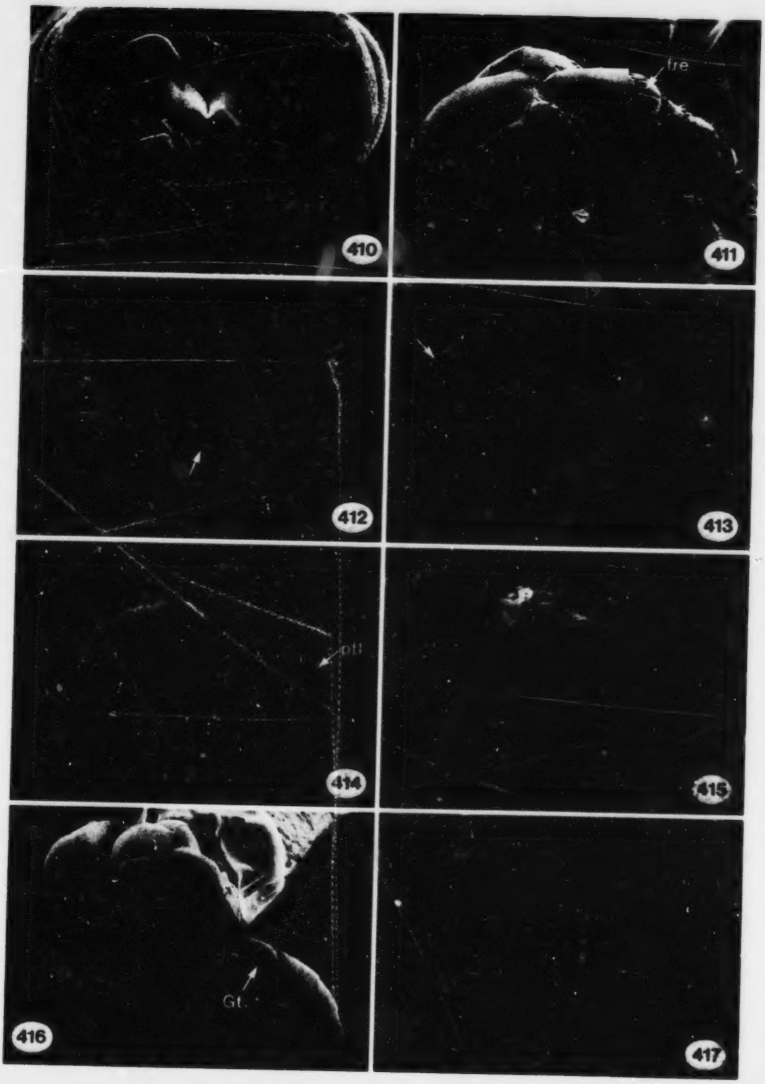
Figs. 402–409. PTEROMALINAE, SPHEGIGASTRINI. 402–404, ***Thinodytes*** ♀: 402, clypeus of n. sp.; 403, clypeus; 404, propodeum and petiole. 405–406, ***Mauleus*** ♂: 405, lower face; 406, propodeum and petiole. 407–409, ***Halticoptera*** ♀: 407, lower face; 408, mesosoma; 409, propodeum and petiole.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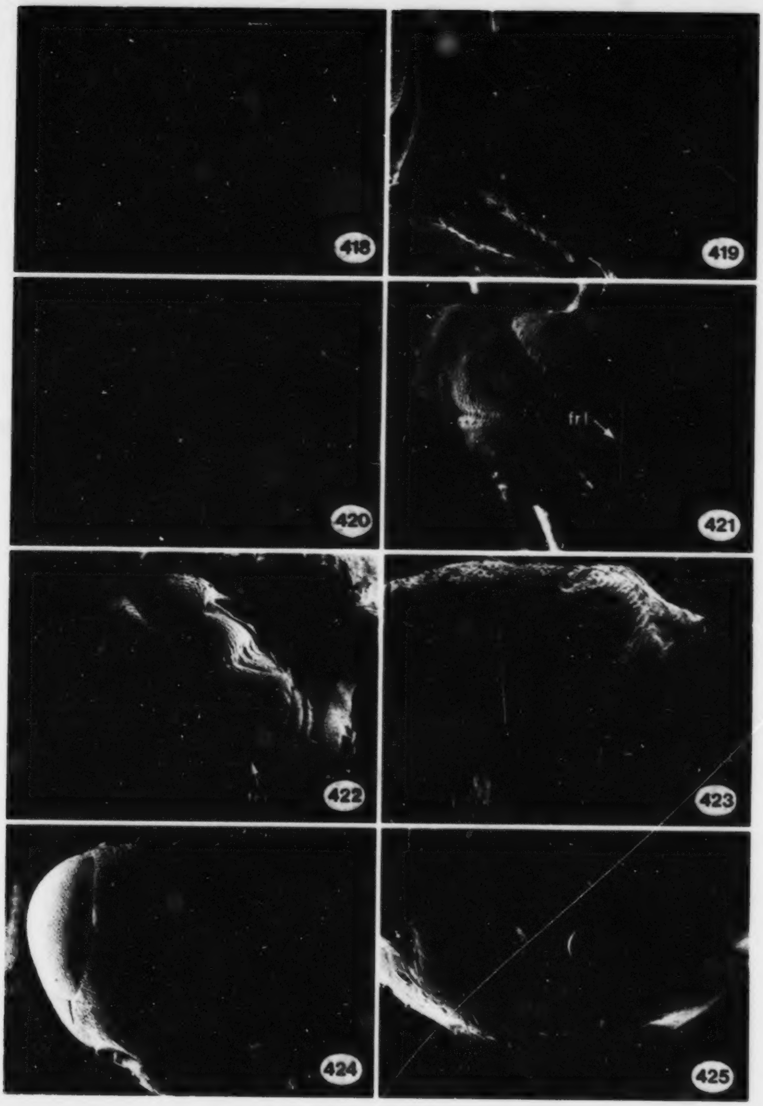
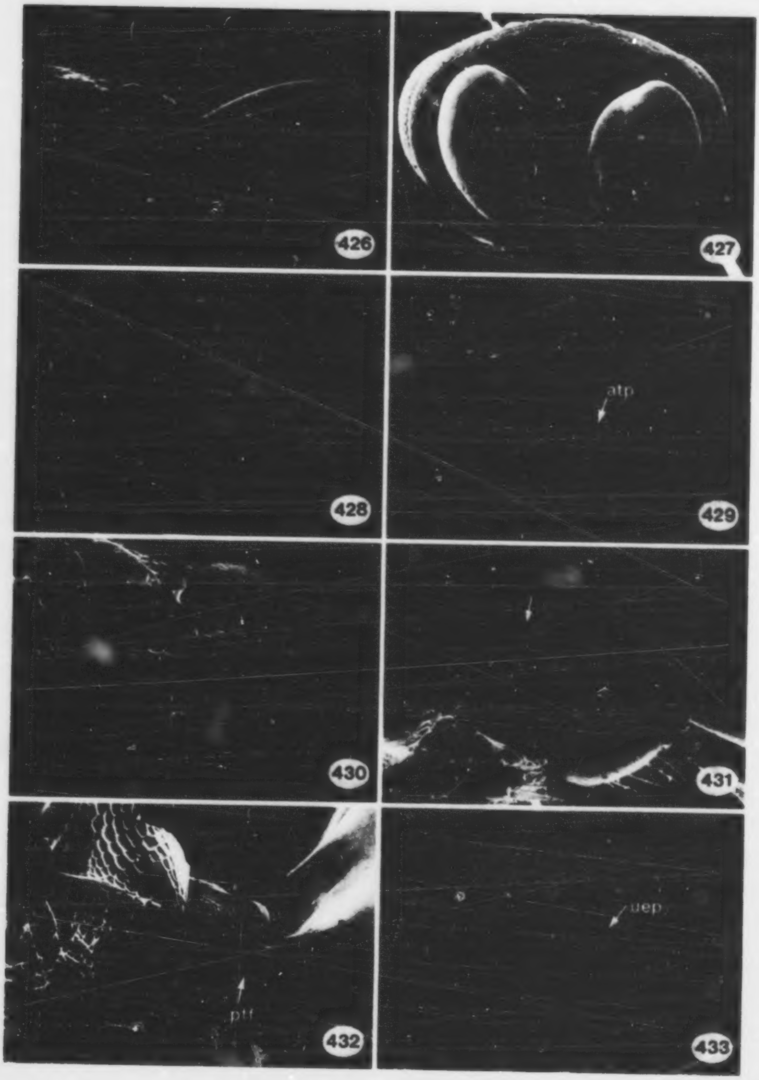
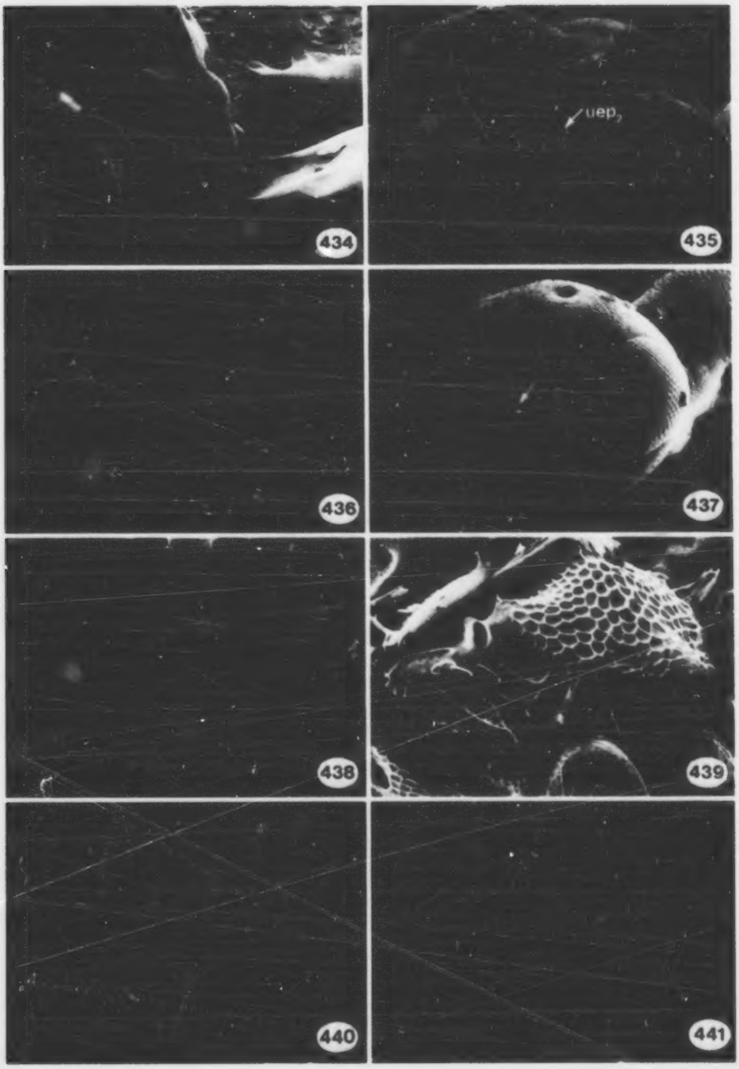
Figs. 410–417. 410, SPHEGIGASTRINI, ***Halticoptera***, ♀ head (posterior). 411–415, MISCOGASTRINI. 411, ***Lamprotatus splendens*** Westwood, ♀ mesosoma. 412–413, ***Seladerma*** ♀: 412, lower face; 413, mesosoma. 414–415, ♀ propodeum and petiole: 414, ***Sphaeripalpus***; 415, ***Miscogaster***. 416–417, PTEROMALINI. 416, ***Coruna clavata*** Walker ♀. 417, ***Ammeia***, ♀ mesosoma.



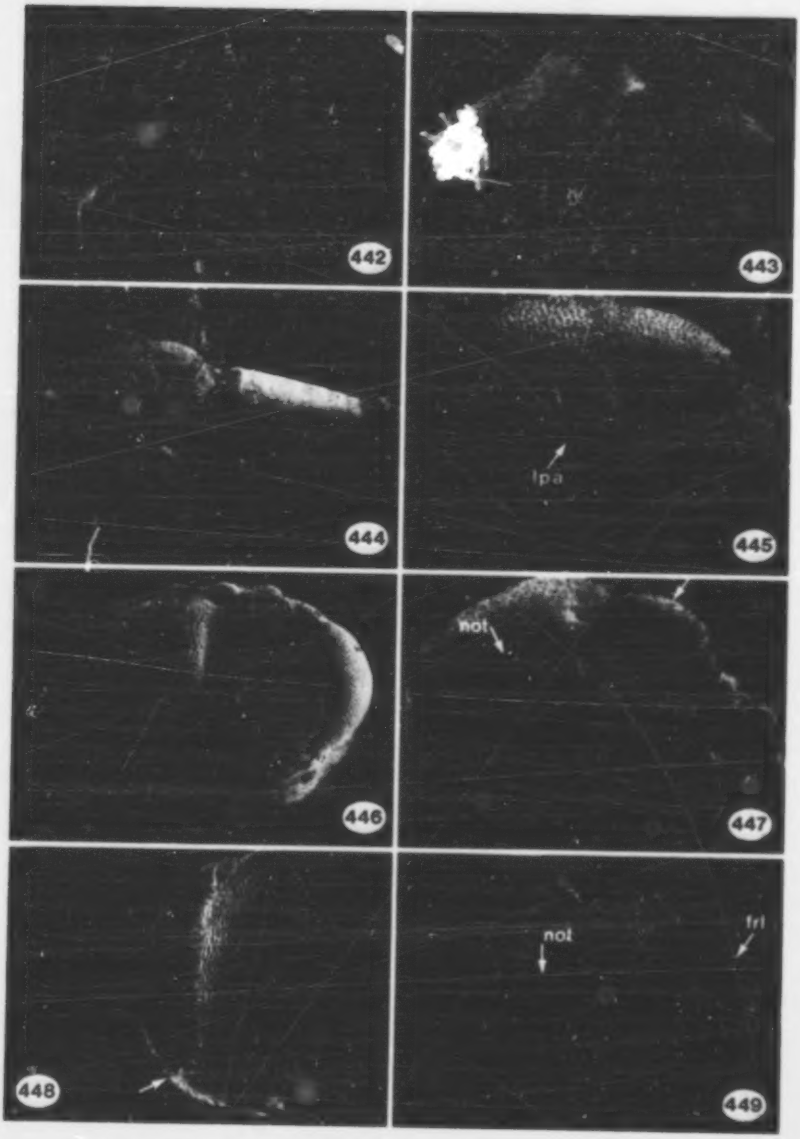
Figs. 418–425. 418, MISCOGASTERINI, ***Ammeia*** ♀. 419–424, PTEROMALINI. 419–421, ***Gastracanthus conicus*** (Girault): 419, ♂ mesosoma; 420, ♂ lower face; 421, ♀ mesosoma. 422, ***Platygerrhus columbianus*** (Ashmead), ♀ mesosoma. 423–424, ***Plutothrix***: 423, ♀ mesosoma (pronotum to right); 424, head. 425, SPHEGIGASTRINI, ***Cyrtogaster trypherus*** (Walker), ♀ lower face.



Figs. 426–433. 426–431, SPHEGIGASTERINI. 426–427, ***Cyrtogaster trypherus*** (Walker) ♂: 426, propodeum and metasoma; 427, palpi. 428–429, ***Bubekia*** ♀: 428, mesosoma; 429, lower face. 430–431, ♀ propodeum and petiole: 430, ***Toxeuma aciculare*** Heydon; 431, ***Notoglyptus luteicrus*** Heydon. 432–433, PTEROMALINI, ***Pachycrepoideus vindemmiae*** (Rondani) ♀: 432, propodeum–base of gaster; 433, mesosoma.



Figs. 434–441. 434–435, PTEROMALINI. 434, ***Pachyneuron eros*** Girault ♀ petiole. 435, ***P. siphonophorae***, ♀ mesosoma. 436–437, PANSTENONINAE, ***Panstenon poaphilum*** Heydon: 436, ♀; 437, ♀ head. 438–439, PTEROMALINAE, SPEGIGASTRINI. 438, ***Sphegigaster salicina*** Heydon & LaBerge, ♀ lower face. 439, ***S. cracentis*** Heydon & LaBerge, ♀ propodeum. 440–441, PTEROMALINI. 440–441, ♀ head: 440, ***Cratomus***; 441, ***Roptrocerus xylophagorum*** (Ratzeburg).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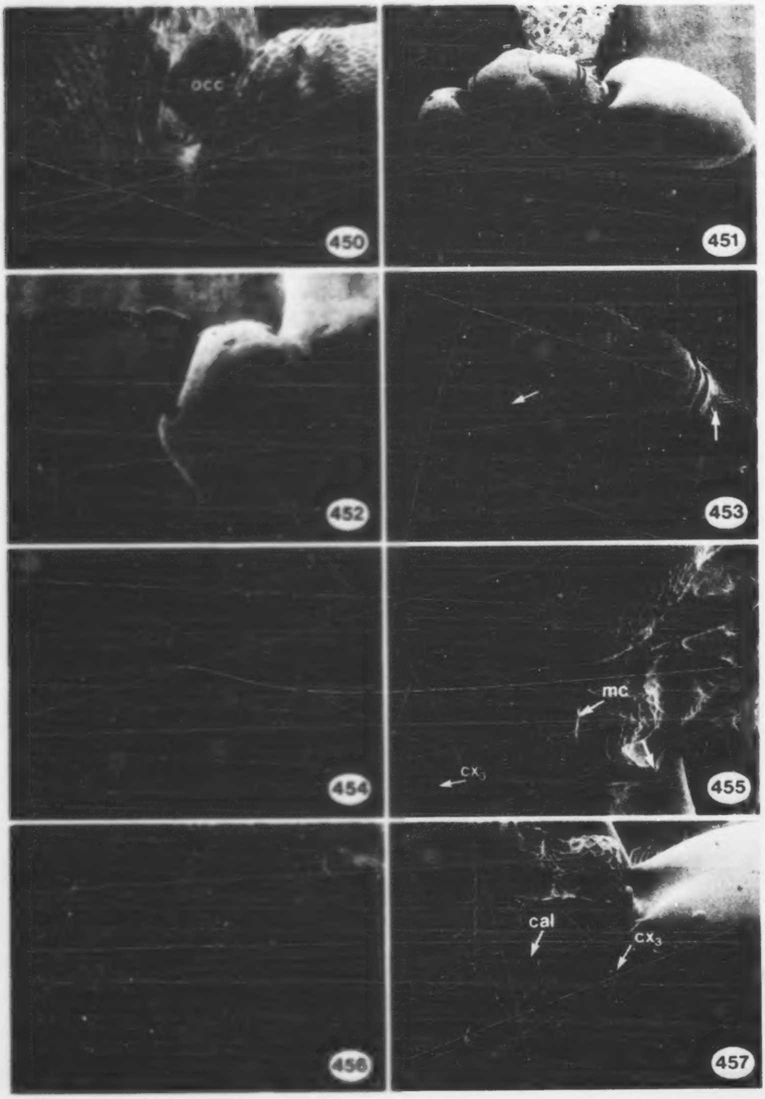
Figs. 442–449. 442–443. ***Brachycaudonia*** ♂: 442, lower face; 443, mesosoma. 444–445. ***Boharticus***: 444, ♀; 445, ♀ mesosoma. 446–447. ***Epipteromalus***: 446, ♀ head; 447, ♂ mesosoma. 448. ***Muscidifurax zaraptor*** Kogan and Legner, ♀ head. 449, ***Schizonotus latus*** (Walker), ♀ head and mesosoma.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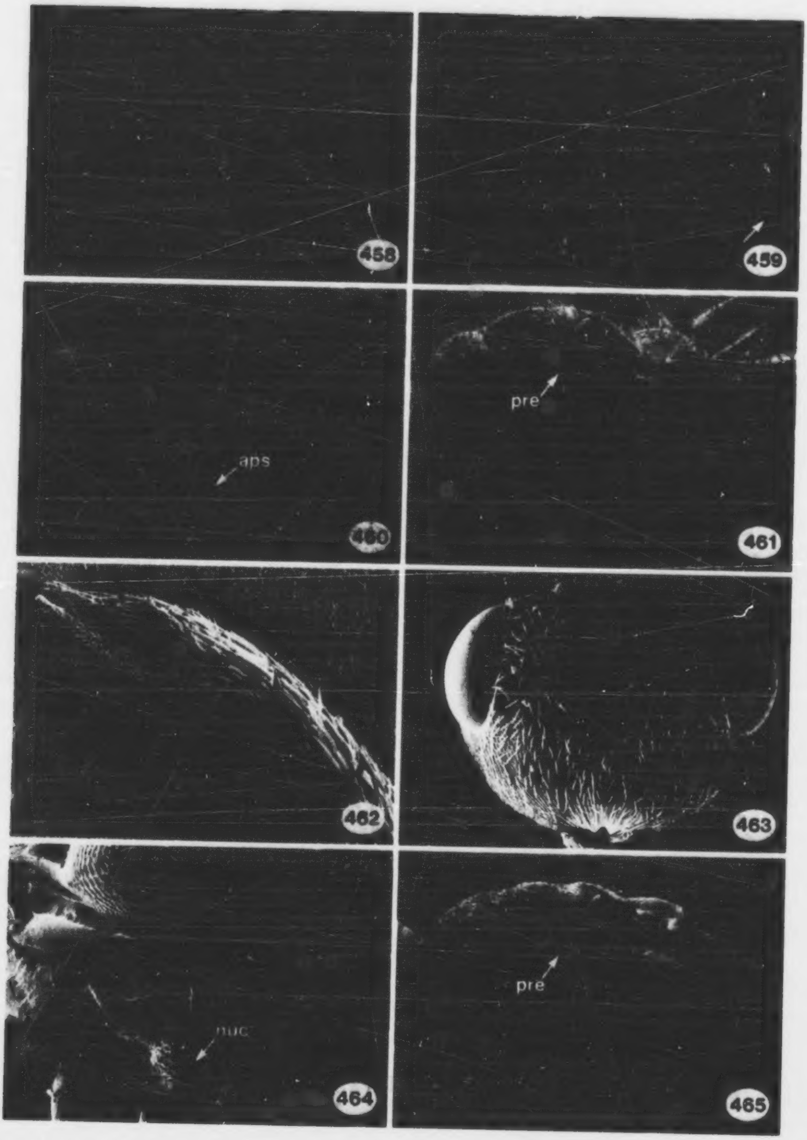
Figs. 450–457. 450, ***Dibrachys cavus*** (Walker), ♀ head and pronotum (dorsolateral). 451–452, ***Nasonia vitripennis*** (Walker): 451, ♀; 452, ♀ head and antenna. 453–454, ♀ head and mesosoma: 453, ***Trichomalopsis***; 454, ***Quercanus luteogaster*** Heydon. 455, ***Dinotiscus***, ♀ propodeum. 456–457, ***Trichomalus*** ♀: 456, thorax; 457, propodeum and base of gaster.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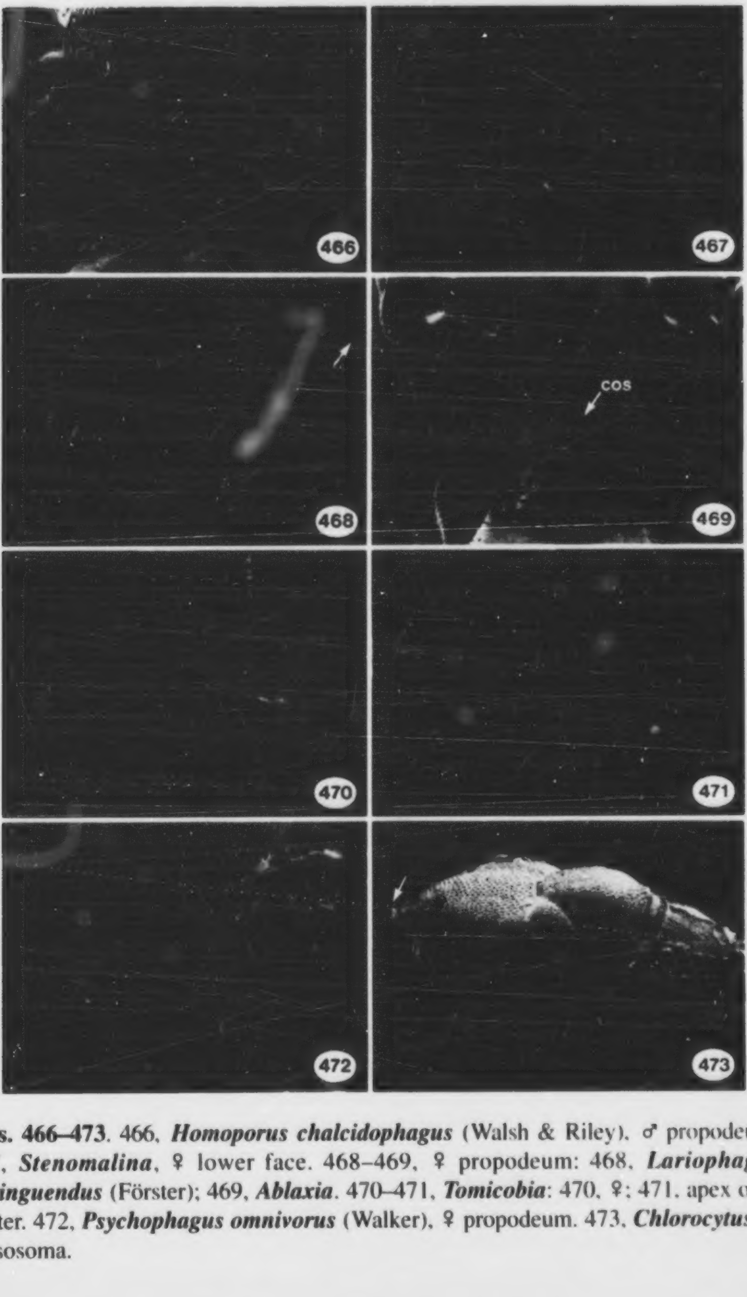
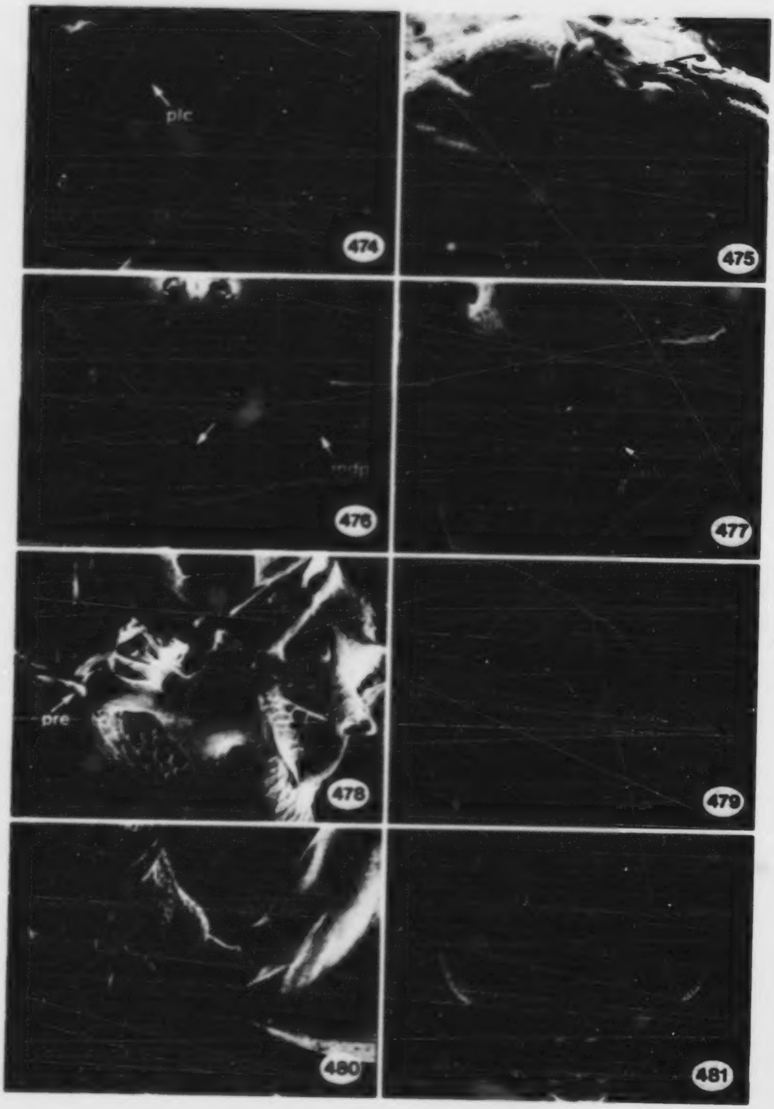
Figs. 458–465. 458, ***Spaniopus***, ♀ mesosoma. 459–460, ***Peridesmia discus*** (Walker) ♀: 459, mesosoma; 460, propodeum. 461, ***Norbanus***, ♂ mesosoma. 462–464, ***Lysirina polychroma*** Heydon ♀: 462, apex of clava; 463, head; 464, propodeum. 465, ***Homoporus chalcidiphagus*** (Walsh & Riley), ♂ mesosoma.



Figs. 466–473. 466, ***Homoporus chalcidophagus*** (Walsh & Riley), ♂ propodeum. 467, ***Stenomalina***, ♀ lower face. 468–469, ♀ propodeum: 468, ***Lariophagus distinguendus*** (Förster); 469, ***Ablaxia***. 470–471, ***Tomicobia***: 470, ♀; 471, apex of ♀ gaster. 472, ***Psychophagus omnivorus*** (Walker), ♀ propodeum. 473, ***Chlorocytus***, ♀ mesosoma.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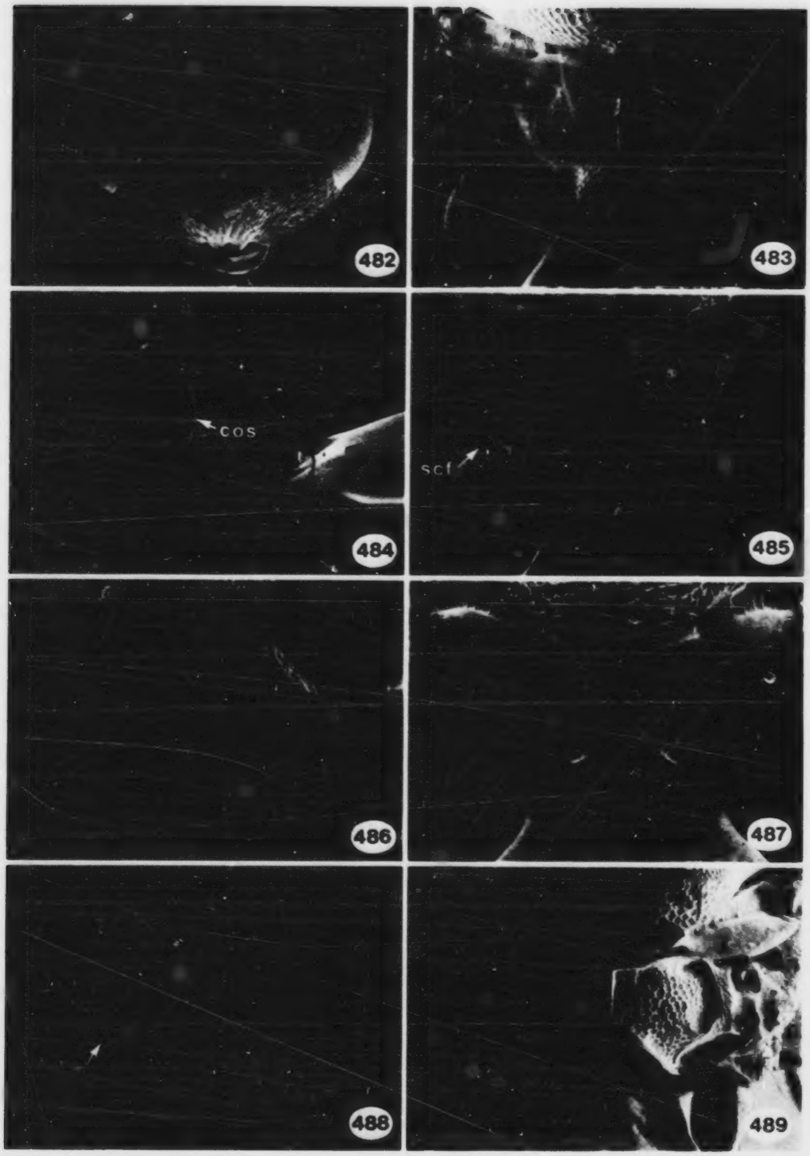
Figs. 474–481. 474–475, ***Chlorocytus***: 474, propodeum; 475, ♀ mesosoma. 476–477, ***Catolaccus aeneoviridis*** (Girault) ♀: 476, lower face; 477, propodeum. 478–479, ***Guolina psenophaga*** Heydon: 478, ♀ posterior of mesosoma (dorsolateral); 479, ♀. 480, ***Hypopteromalus tabacum*** (Fitch), ♀ middle of body. 481, ***Acaenacis***, ♀ head.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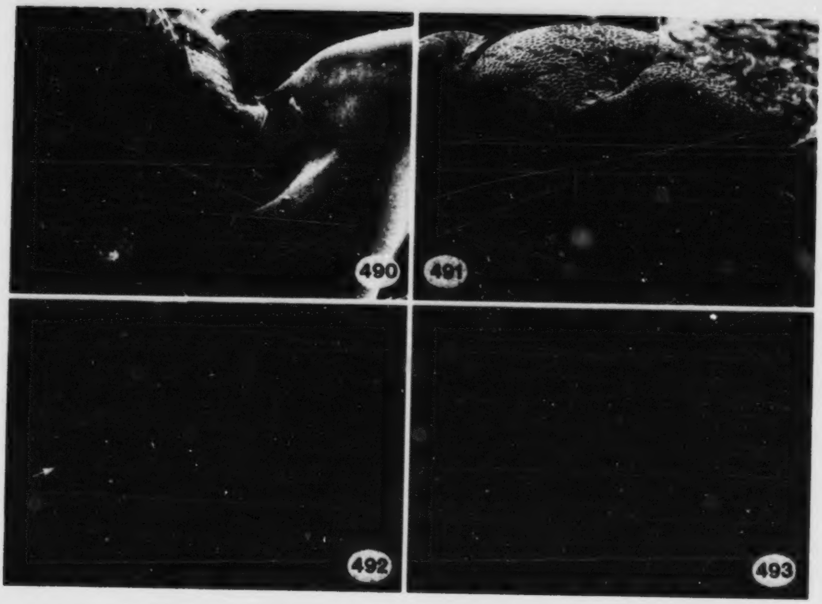
Figs. 482–489. 482, ***Psilocera***, head. 483–489, ♀ propodeum: 483, ***Psilocera***; 484, ***Neocatolaccus***; 485, ***Heteroschema***; 486, ***Dinarmus***; 487, ***Pseudocatolaccus***; 488, ***Anisopteromalus calandrae*** (Howard); 489, ***Oxysychus***.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Figs. 490–493. 490, ***Lyrcus***, ♀ propodeum. 491–493, ♀ mesosoma: 491, ***Lyrcus***; 492, ***Meraporus***; 493, ***Mesopolobus***.

Chapter 18. SIGNIPHORIDAE

James B. Woolley

Recognition. Signiphoridae are distinguished by the following combination of features: forewing disc bare except for a few setae; antenna with 2–4 anelli and unsegmented clava; propodeum with triangular median region set off by lateral sulci; notauli absent; scutellum transverse, the axillae indicated only by internal, oblique carinae and not visible externally. In addition, most species have 1–4 long spines on the mesofemur and an obconic mesotibia that has long, dorsal, apical and basal spines.

Systematics. Most of the features that characterize Signiphoridae appear to be uniquely derived features. The family is almost certainly monophyletic and may be related to Aphelinidae (Gibson 1989) or some group within Aphelinidae such as Azotinae (Woolley 1988). Two subfamilies are currently recognized, the Signiphorinae contains only *Signiphora*, whereas Thysaninae contains three genera: *Chartocerus*, *Clytina* Erdős, and *Thysanus*. It is likely that Thysaninae is paraphyletic with respect to Signiphorinae (Woolley 1988).

Biology/Fauna. Signiphoridae contain about 75 described species, of which about 20 are found in the Nearctic region; however, many undescribed species are known, particularly from the Neotropical and Nearctic regions. *Clytina* contains two known species, *C. giraudi* Erdős from Europe and an undescribed species from Central America. *Clytina giraudi* is a parasite of pupae of Chloropidae (Erdős 1957); specimens of the undescribed species have been collected by sifting bark and bracket fungi. *Chartocerus*, *Signiphora*, and *Thysanus* are essentially cosmopolitan, though the last two genera are most diverse in the Neotropical region. Little is known of the biology of *Thysanus*. Members are often stated to be hyperparasites (e.g., Rozanov 1965), but a species that appears to be *Thysanus ater* Walker was reared from the eggs of *Neurocolpus longirostris* Knight (Miridae) on buckeye and pistacio in central California (R. Rice, personal communication), and an undescribed species was reared from the eggs of *Agrilus anxius* Gory (Buprestidae) (Barter 1957). A few other rearings indicate Diaspididae (Homoptera) as hosts of *Thysanus*.

Species of *Signiphora* are assigned to four species groups (Woolley 1988) that differ biologically in a reasonably consistent way. With one known exception, members of the *dipterophaga* group parasitize pupae of Diptera, commonly Tachinidae. This species group is primarily Neotropical, although some species occur in the United States and temperate Mexico. The *bifasciata* group contains parasites of Psyllidae, Coccidae, and Pseudococcidae, and species of the *coleoptratus* group are apparently hyperparasites of Pseudococcidae. Members of the cosmopolitan *flavopalliata* group are, with few exceptions, primary or secondary parasites of Diaspididae and Aleyrodidae. Species in this group that are hyperparasites appear to be obligate secondary parasites (DeBach 1953), but several species are primary parasites, particularly of Diaspididae (Woolley 1990). Some of these primary parasites have an unusual mode of development in which first and second instar larvae develop as internal parasites and later instars develop as external parasites (Quezada et al. 1973). *Signiphora coquilletti* Ashmead, an obligate hyperparasite of Aleyrodidae, has the unusual behavior of constructing a silk web over the host after oviposition (Woolley and Vet 1981). One undescribed species of *Signiphora* in the *flavopalliata* group has been reared from the eggs of several species of Hemiptera. Uniparental reproduction is common in *Signiphora*. Males are rare or unknown in several well known species, though other species are clearly biparental. Certain species of *Signiphora* provide valuable natural control of potential pests (Agekyan 1968, DeBach et al. 1958), but these species have not been deliberately manipulated for biological control purposes.

Species of *Chartocerus* are obligate hyperparasites of a variety of Homoptera (Clausen 1924, Rosen et al. 1992), although some species also parasitize the pupae of Chamaemyiidae, predators of Pseudococcidae. One species of *Chartocerus* has been reared from the mummies of parasitized Aphididae (R. Cave, personal communication).

Literature. Rozanov (1965) reviewed the world fauna with particular reference to nomenclatural problems and the Palearctic species, including useful discussions of the putative subgenera of *Chartocerus*. De Santis (1968) reviewed the family with particular attention to the higher classification and nomenclatural problems. Subba Rao (1974) provided a useful review of two species groups of *Signiphora*, the *dipterophaga* and *coleoptratus* groups, which he treated as valid genera. Hayat and Verma (1979) catalogued the signiphorids of India and provided host records for each species. This paper is particularly useful for *Chartocerus* species. Trjapitzin (1987) provided a key to the species of the European part of the former U.S.S.R., which should be reasonably reliable for other parts of Europe. Woolley (1988) gave a key to the species groups of *Signiphora* in the sense used here.

Use of key. Signiphoridae is a small but well defined family that is infrequently encountered by the general collector. The following key treats the Nearctic region as America north of Mexico, but including highland Mexico north of the Isthmus of Tehuantepec including the Sierra Madre Occidental, Sierra Madre Oriental, Sierra Madre del Sur, the central plateau, and the transverse volcanic ranges.

The marginal vein of the forewing of Signiphoridae bears a number of long, dorsal setae on its anterior (leading) and posterior (trailing) margins. The presence or absence of particular setae on the forewing is useful for both identification and classification of Signiphoridae. Figure 4 illustrates a marginal vein on which six dorsal setae are present. The four anterior setae are denoted M2, M2b, M3, and M4. The posterior, dorsal setae are M5 and M6. Some species bear another seta basal to both M2 and M5, which is denoted M1. Two rules allow this scheme to be applied with very few exceptions: seta M1, if present, is always basal to seta M5, which is always present, and seta M3 is always apical to seta M6 if the latter is present.

Key to genera of Signiphoridae

1 Protibia with apical spur not having comb of fine setae (Fig. 1); median triangular area of propodeum without lateral lamelliform process. *Female*: flagellum with 4 anelli 2

– Protibia with apical spur having comb of fine setae (Fig. 2); median triangular area of propodeum with lateral lamelliform process (Fig. 3). *Female*: flagellum with 3 anelli [one group of Neotropical species with 4 anelli] .... ***Signiphora*** Ashmead

Fauna: 14 described spp.; world, 37 described and many undescribed spp., particularly in Neotropical region. **Hosts**: primary or secondary parasites of Diaspididae, Aleyrodidae, Coccidae, Pseudococcidae and rarely other Homoptera, and parasites of pupae of Tachinidae and Drosophilidae (see Quezada et al. 1973, Agekyan 1968, and Woolley 1990).

2(1) Marginal vein of forewing with 6 or 7 dorsal setae: seta M6 present and seta M2b present between setae M2 and M3 (Fig. 4); head with occipital margin acute or narrowly rounded; mesofemur with 3 or 4 long spines; hind wing with posterior margin rounded. *Male*: genitalia with median denticles, digitus with apical denticles only (Fig. 6) .... ***Chartocerus*** Motschulsky

Fauna: 3 described spp.; world, 34 described spp. **Hosts**: obligate hyperparasites of Pseudococcidae, Coccidae, Psyllidae, and Aphididae through Encyrtidae and Aphelinidae, though some species also parasitize pupae of Diptera, such as Chamaemyiidae (see Clausen 1924 and Rosen et al. 1992).

– Marginal vein of forewing with 4 or 5 dorsal setae: seta M6 absent and seta M2b not present between M2 and M3 (Fig. 7); head with occipital margin rounded; mesofemur usually with 1 long spine; hind wing with anterior and posterior margins parallel. *Male*: genitalia without median denticles, digitus with apical and subapical denticles (Fig. 5) .... ***Thysanus*** Walker

Fauna: 3 described spp.; world, 4 described and several undescribed spp. **Hosts**: Diaspididae, except for one undescribed sp. from eggs of *Agrilus anxius* Gory (Buprestidae).

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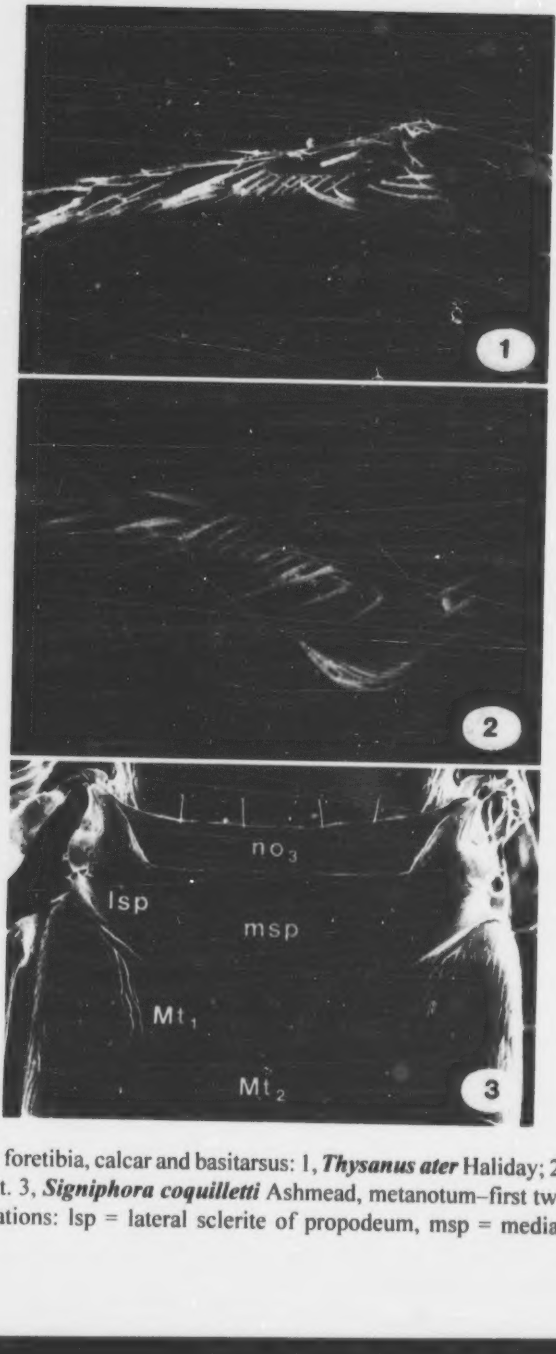
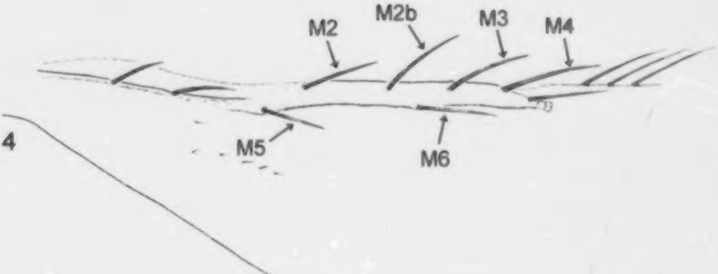


Figs. 1–3. 1–2, foretibia, calcar and basitarsus: 1, ***Thysanus ater*** Haliday; 2, ***Signiphora flavella*** Girault. 3, ***Signiphora coquilletti*** Ashmead, metanotum–first two metasomal terga (abbreviations: lsp = lateral sclerite of propodeum, msp = median sclerite of propodeum).



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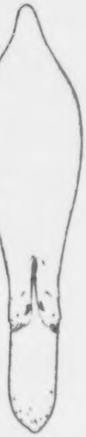

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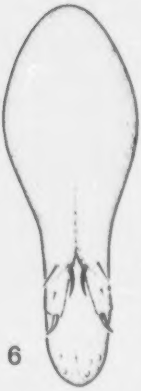

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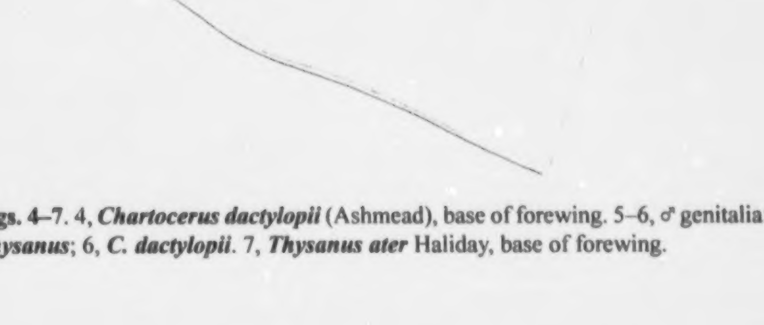

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Figs. 4–7. 4, ***Chartocerus dactylopii*** (Ashmead), base of forewing. 5–6, ♂ genitalia: 5, ***Thysanus***; 6, ***C. dactylopii***. 7, ***Thysanus ater*** Haliday, base of forewing.

Chapter 19. TANAOSTIGMATIDAE

John LaSalle

Recognition. Tanaostigmatidae are distinguished by the following combination of features: mesopleuron (acropleuron) large, longer than high, and convex (Figs. 5, 6); notauli present, sinuate, usually converging or meeting at midline of mesoscutum (Figs. 3, 4); prepectus swollen, rounded anteriorly, in dorsal view appearing as distinct shoulder (Figs. 3–6); mesotarsus ventrally with at least basitarsus (and usually all segments) having 2 rows of peg-like spines; marginal vein several times as long as wide and usually longer than postmarginal or stigmal veins (Figs. 7–9); cerci near apex of gaster; pronotum short, usually vertical and in dorsal view not or barely visible (Figs. 3, 4); antenna with 2 anelli and 6 funicular segments (Figs. 10, 11) or, rarely, with 3 anelli and 5 funicular segments.

Systematics. The single synapomorphy that defines Tanaostigmatidae as a monophyletic group and the best character for distinguishing members is the large, swollen prepectus (Figs. 3–6). The swollen prepectus is most distinct in dorsal view (Figs. 3, 4), where it appears as a prominent shoulder on each side of the mesosoma. Tanaostigmatidae is generally a well-defined family based on this character; however, there is one problematical taxon associated with this family. The monotypic Japanese genus *Cynipencyrtus* Ishii, a parasite of Cynipidae, was transferred from Encyrtidae to Tanaostigmatidae by LaSalle and Noyes (1985); however, not all authors are convinced that it is properly classified here (e.g., Gibson 1989).

Tanaostigmatidae are most closely related to Encyrtidae and Eupelmidae. All Encyrtidae and Tanaostigmatidae have a swollen, convex mesopleuron composed entirely of the acropleuron (Figs. 5, 6), and the middle leg has a large tibial spur and a row of peg-like spines on the basitarsus. Eupelmidae also share these features, except for male Eupelminae and both sexes of some apparently primitive Calosotinae (see chapter 11). Exact relationships among these three families are not resolved, but LaSalle (1987) and Gibson (1989) considered Tanaostigmatidae to be more closely related to Encyrtidae than to Eupelmidae.

Biology. Tanaostigmatidae have an unusual biology that differs strikingly from their closest relatives. Whereas most Chalcidoidea (including Encyrtidae and Eupelmidae) are parasites of other insects, Tanaostigmatidae are predominantly phytophagous. They are mainly associated with galls and, in general, have been presumed to be the gall formers. However, very few detailed biologies are known for members and exceptions to gall-forming exist. Favored host plants are woody shrubs and trees in the family Fabaceae. The Fabaceae (Mimosoidea) contain the only known host plants for North American Tanaostigmatidae, although other host groups are known in other regions.

Although many records of tanaostigmatids as gall-formers are undoubtedly correct, inquilinism may be more common than previously suspected. Fernandes et al. (1987) reported one species, subsequently described as *Tanaostigmodes fernandesi* by LaSalle (1987), as an inquiline in a gall of *Anadiplosis* (Cecidomyiidae) on *Machaerium aculeatum* (Fabaceae: Faboidea) in Brazil. Galls that contained the inquiline were larger and of a different shape and consistency than normal cecidomyiid galls. The cecidomyiid larvae were never found in galls with *T. fernandesi*, and it was presumed that they were killed and/or consumed by the inquiline larva which then took over the gall.

Tanaostigmodes cajaninae LaSalle, from India, is an exception to strict association with galls. This species infests seeds of pigeon pea, *Cajanus cajan* (Fabaceae: Faboidea), as well as several other plants, and is considered as a potential pest species (Lateef et al. 1985). One economically important species, *Tanaostigmodes haematoxyli* (Dozier), is known from the New World and is recorded as a pest of logwood, *Haematoxylon campechianum* (Fabaceae: Caesalpinoidea), in Haiti (Dozier 1932). Logwood was not only important to the dye industry, but was also the chief honey plant on the island at that time. *T. haematoxyli* caused such extensive damage to seed pods that in some areas it prevented natural reseeding of this tree.

Fauna/Literature. The family is small, with only 88 described species, and is only rarely encountered by the general collector. Tanaostigmatidae are most abundant in the New World tropics but occur throughout tropical and, in some cases, subtropical regions of the world. Seventy-four species occur in the New World and the 16 Nearctic species can be identified using LaSalle (1987). The New World species extend from northern Argentina to subtropical areas of the southern United States.

Use of key. The following key treats the Nearctic region as America north of Mexico.

Key to genera of Tanaostigmatidae

1 Head and mesosoma with large, flattened, white setae (Figs. 2, 4, 6); forewing **either** with stigmal vein slender, straight or only slightly curved, and perpendicular or nearly so to postmarginal vein (Fig. 9) **or** with many large, dark, modified setae giving wing a patterned appearance (Fig. 8). *Female*: antenna with all funicular segments distinctly wider than long; scape 1.5–2.5 times as long as wide, with large, flattened ventral expansion (Fig. 11) .... ***Tanaostigma*** Howard

Key: LaSalle (1987). **Fauna**: 2 spp., *T. stanleyi* LaSalle in USA (AZ, NM, TX) and northern Mexico, and *T. slossonae* (Crawford) in USA (FL) and Caribbean. **Hosts**: Fabaceae (Mimosoidea).

– Head and mesosoma without large, flattened setae (Figs. 1, 3, 5); forewing usually different, the stigmal vein generally curved and wing never with modified setae (Fig. 7). *Female*: antenna never with all funicular segments distinctly wider than long (Fig. 10); scape variable .... ***Tanaostigmodes*** Ashmead

Key: LaSalle (1987). **Fauna**: 14 spp. in USA (AZ, CA, FL, NM, TX). **Hosts**: Fabaceae (Mimosoidea).

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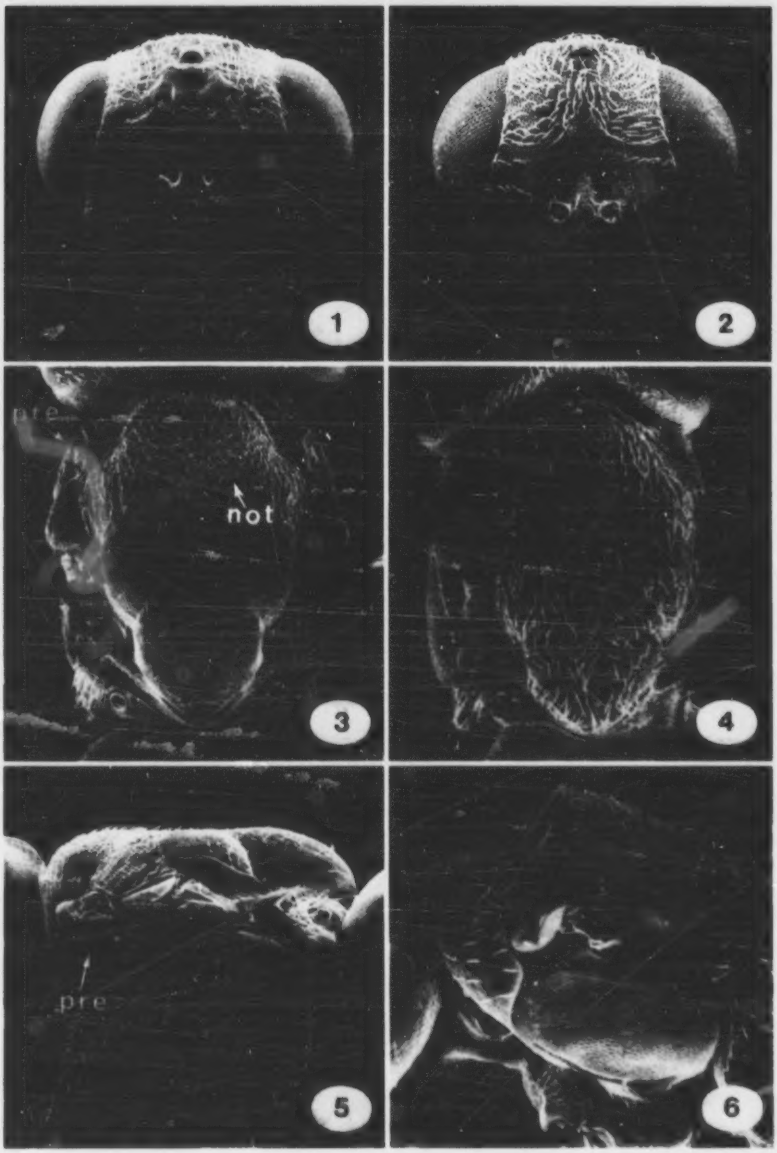
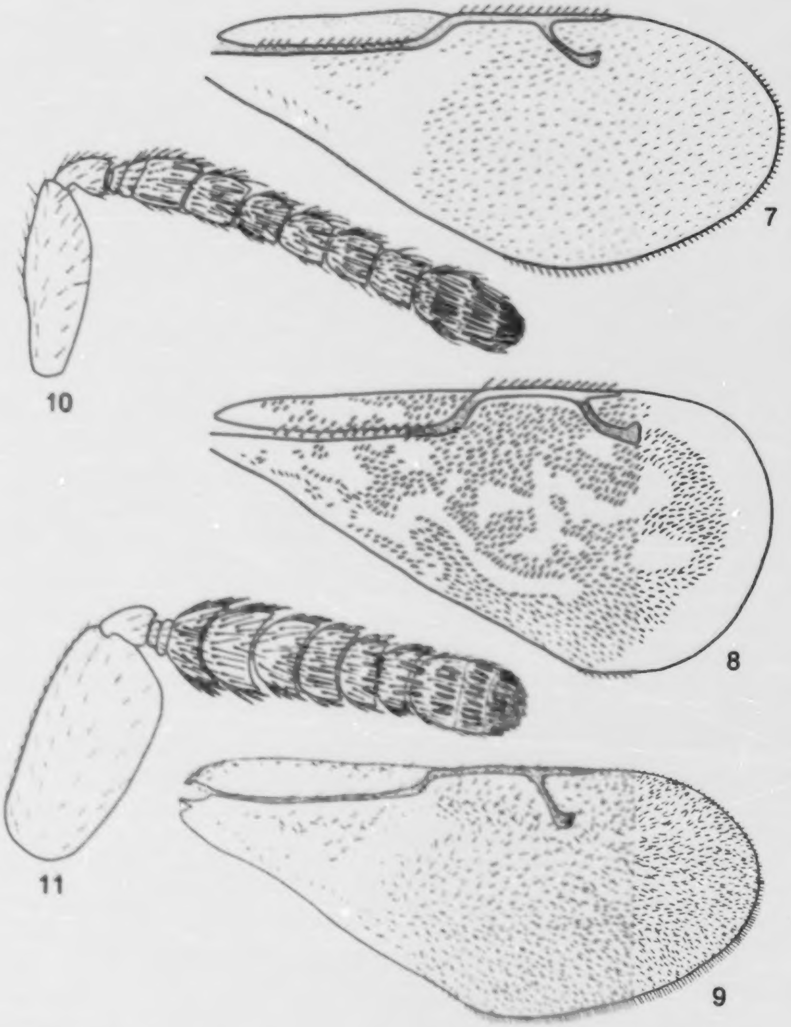


Figs. 1–6. 1–2, head: 1, ***Tanaostigmodes albiclavus*** Girault; 2, ***Tanaostigma stanleyi*** LaSalle. 3–4, mesosoma: 3, ***T. albiclavus***; 4, ***T. stanleyi***. 5–6, mesosoma (lateral): 5, ***T. albiclavus***; 6, ***Tanaostigma slossonae*** (Crawford).



Figs. 7–11. 7–9, forewing: 7, ***Tanaostigmodes albiclavus*** Girault; 8, ***Tanaostigma stanleyi*** LaSalle; 9, ***Tanaostigma slossonae*** (Crawford). 10–11, antenna: 10, ***T. albiclavus***; 11, ***T. stanleyi***.

Chapter 20. **TETRACAMPIDAE**

Zdenek Bouček

Recognition. Tetracampidae are recognized by the following combination of features: tarsi 5-segmented, at least in females; antenna with fewer than 13 segments but with at least 5 funicular segments; protibial spur moderately strong and distinctly cleft; head with fine but complete horseshoe-like occipital carina; and mesoscutum with complete notauli. Individuals of all genera also have the posterior margin of the pronotum very thin and closely applied to the mesoscutum. Females of many species also have Gt_1 with the posterior margin transversely depressed.

Systematics. Bouček (1958) divided the family into two subfamilies, Platynocheilinae and Tetracampinae. Platynocheilinae have 5-segmented tarsi in both sexes and the first flagellar segment (anellus) is large and either oblong or elongate. The funicle is 6-segmented in females and 5-segmented in males; males also have a peculiar enlargement of the marginal vein (Fig. 3). Males of Tetracampinae have 4-segmented tarsi (Fig. 6) and in both sexes the anellus is small, often thin, and then sometimes fused with the following segment. New World species of Tetracampinae have a 6-segmented funicle and 3-segmented clava (in some extralimital forms the claval segments may be fused). The forewing is almost completely setose and has a very narrow costal cell, very long marginal vein, and a very short stigmal vein with a long, oblique uncus. Most Tetracampinae (all New World species) have the scutellum bare except for two pairs of strong bristles (Fig. 5), which is reminiscent of some Eulophidae and explains why tetracampids were often classified in Eulophidae.

Biology. Nearctic species are parasites of the eggs or larvae of Diptera and Hymenoptera. Species of some extralimital genera also parasitize eggs of Chrysomelidae, in particular Cassidinae.

Fauna. The family is represented by at least seven species in three genera in the Nearctic region. All of the genera are also found in other zoogeographical regions, but *Platynocheilus* and *Dipriocampe* occur only in the northern hemisphere.

Literature. The Tetracampidae was not included in Krombein et al. (1979). Yoshimoto (1978) and Bouček (1993) have treated most Nearctic species. Bouček (1958) revised the European fauna. Graham (1963) provided additional notes on synonymy of European species.

Key to genera of Tetracampidae

1 Body long and narrow (Fig. 2), with pronotum almost as long as broad; scutellum with 2 or 3 pairs of setae, these as short as setae on mesoscutum; propodeum broadly bare; tarsi 5-segmented. *Female*: antenna 12-segmented, including an elongate anellus. *Male*: antenna similar but only 11-segmented, the funicle 5-segmented; marginal vein greatly widened (Fig. 3) .... PLATYNOCHEILINAE, ***Platynocheilus*** Westwood

Key: Bouček (1993). **Fauna**: 2 spp., *P. aeneus* Bouček (1993) (Figs. 1–3) in Canada (AB, ON) and *P. cuprifrons* (Nees) in Canada (NF) and USA (NH). **Hosts**: unknown, but European species parasitize leaf-mining Agromyzidae.

– Body, especially mesosoma, shorter, with pronotum clearly broader than long (Fig. 5); scutellum with 2 pairs of long bristles; propodeum extensively setose, the setae converging towards midline (Figs. 5, 8); antenna 11- or 12-segmented, but if 12-segmented then with very short, transverse anellus (Fig. 7). *Male*: tarsi 4-segmented; marginal vein normal (Fig. 5) .... TETRACAMPINAE, 6

2(1) Gaster on short, inconspicuous, subtriangular petiole; propodeum with median bare strip, its sides, the metapleuron, and metacoxa with sparse setae; antenna with pedicel slightly longer than broad (Fig. 4) .... ***Dipriocampe*** Bouček

Fauna: 1 sp., *D. diprioni* (Ferrière), introduced into Canada from Europe and established in ON (see also Clausen 1978). **Hosts**: eggs of *Diprion hercyniae* Hartig (Diprionidae).

– Gaster on conspicuous, subquadrate to oblong petiole (Figs. 5, 8); propodeum, metapleuron, and most of metacoxa entirely and densely setose (Fig. 5); antenna with pedicel at least almost twice as long as broad .... ***Epiclerus*** Haliday

Fauna: at least 4 spp., only 2 described, *E. nearcticus* Yoshimoto (1978) in Canada (ON), USA (NC), and Mexico (Nuevo Leon, San Luis Potosi), and *E. acutus* Bouček (1993) in Canada (ON). **Hosts**: Agromyzidae mining non-woody parts of plants.

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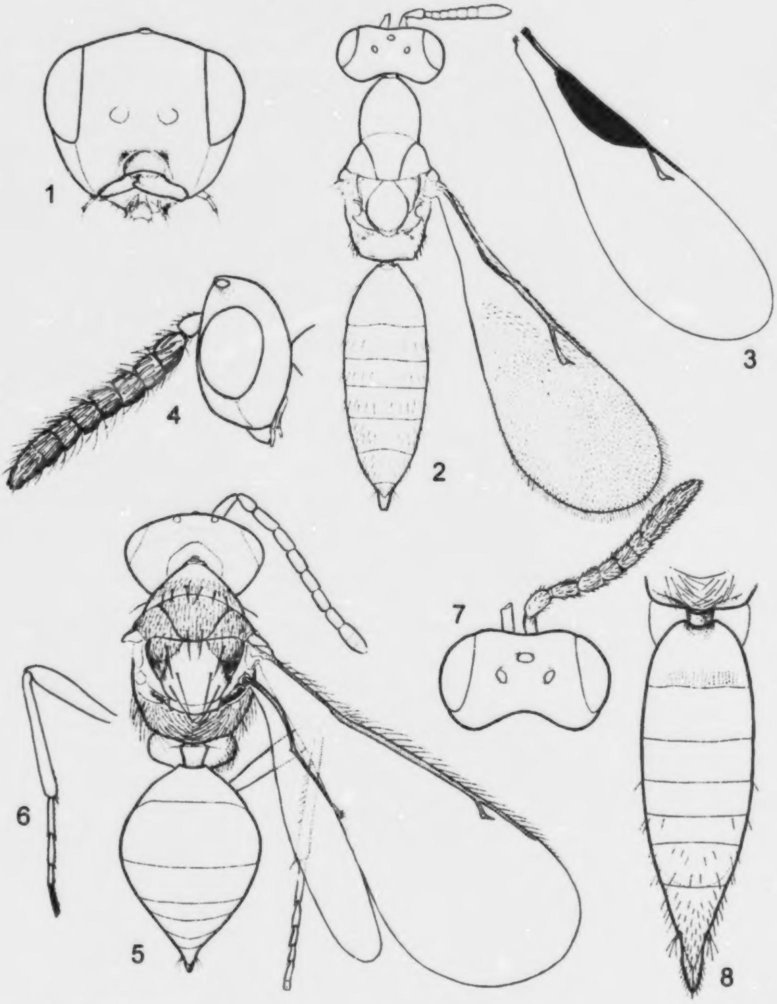

Figs. 1–8. 1–3, ***Platynocheilus aeneus*** Bouček: 1, ♀ head; 2, ♀ body; 3, ♂ forewing. 4, ***Dipriocampe diprioni*** (Ferrière): head and antenna. 5–6, ***Epiclerus nearcticus*** Yoshimoto: 5, ♀ body; 6, ♂ hind leg. 7–8, ***E. acutus*** Bouček: 7, ♀ head and antenna; 8, propodeum and metasoma.

Chapter 21. TORYMIDAE

E. Eric Grissell

Recognition. Females of Torymidae are recognized with certainty only by their exserted cerci, which originate from a secondary (Figs. 14, 15) or tertiary subdivision of Mt_8, and by Mt_9 (often called the epipygium, Figs. 14, 15: epi) being free on all sides except for its basal articulation with Mt_8. No other chalcidoid has the metasoma structured in this manner. Rarely, in some Pteromalidae (e.g., *Cea*), the cerci are exserted (Fig. 16), but they arise from an undivided Mt_8 and there is no Mt_9 (or it is fused with Mt_8) (Fig. 17). Also, in some extralimital pteromalid genera (e.g., *Ditropinotella* Girault from Australia), the last tergum extends as a projection, but this projection is not articulated basally. Whether the projection is entirely Mt_8 or is a fusion of Mt_{8+9} is unknown. In male Torymidae, although the cerci are exserted there is no epipygium, which presents some difficulty in identifying males to family with absolute certainty. I discuss more generalized methods of identifying both sexes below.

The above features are not always easy to see because the terminal parts of the metasoma are tiny and may be contorted, withdrawn into the metasoma, or covered with exudates. Other features of both sexes that are traditionally used to define the family, such as an enlarged metacoxa, presence of an occipital carina, and characteristic wing venation (described below), may help distinguish many individuals, but they do not distinguish all torymids. The elongate ovipositor, possessed by most females, does not distinguish the Torymidae either, because almost all families have several taxa with females having elongate ovipositors. Still, it is usually easier to rely on combinations of these features for an initial family identification than it is to see the autapomorphies described above. Therefore, most torymids (both sexes) may be recognized by the following combination of features (exceptions follow this list): occipital carina present (Figs. 18, 19); stigmal vein shortened (Figs. 26, 28–31); marginal vein at least twice as long as stigmal vein (Fig. 27) and usually 4–10 times as long as stigmal vein (Figs. 28–31); and metacoxa 1.5–3 times as long as procoxa. In females the ovipositor is almost always exserted (Figs. 1, 3, 4).

In relatively few genera (e.g., *Microdontomerus*) there is no occipital carina and in others (e.g., *Ditropinotus* and *Idiomacromerus*) the carina is indistinct or weak enough to be overlooked except under certain angles of light (in this respect, fluorescent light is better than incandescent for examining specimens). Also in these three genera, the metacoxa tends to be nearly subequal in length to the procoxa. In these genera the relatively short stigmal vein, in both sexes 0.2–0.3 times as long as the marginal vein (Figs. 27, 31), and in females the long ovipositor sheaths, distinguish individuals from Pteromalidae. In Megastigminae, which have a well developed occipital carina, the metacoxa is scarcely larger than the procoxa, but in this group the stigmal vein is short and the stigma is posteriorly lengthened (Fig. 25).

Systematics. Major changes in torymid classification have taken place since Grissell (1979) that make the catalog obsolete. Bouček (1978) reduced the subfamily Podagrioninae to a tribe of Monodontomerinae (which was overlooked by Grissell 1979) and later (Bouček 1988) removed the subfamilies Agaoninae and Idarninae (= Sycophaginae) to the Agaonidae. Grissell (1995) reduced the remaining subfamilies from four to two, namely Megastigminae and Toryminae. The historical subfamily Toryminae (of authors) was reduced to the tribe Torymini and the subfamilies Erimerinae and Monodontomerinae were no longer recognized. Genera of Erimerinae were included as part of the tribe Microdontomerini and genera of Monodontomerinae were divided among the tribes Microdontomerini, Monodontomerini, and Torymoidini of the Toryminae (Grissell 1995). The new genus *Zdenekius*, also was added to the fauna (Grissell 1993). The relationship of Torymidae to other Chalcidoidea is uncertain, but the family appears to have some affinity with Pteromalidae and may be derived from somewhere within that apparently paraphyletic assemblage. Also there remains some differences of opinion concerning relationships between Torymidae and Agaonidae (discussed in Bouček 1988 and Grissell 1995). Recently Grissell (1995) presented several hypotheses suggesting additional study, including the possibility that Agaonidae may be a derived clade within the Torymidae, with Epichrysomallinae as an intermediary form between the basal Torymidae and the remaining derived subfamilies of Agaonidae. Though this hypothesis poses problems of paraphyly within the now-recognized Torymidae, it cannot be ruled out based on current evidence. Much additional study remains to be undertaken, especially within taxa of Agaonidae, to find and test hypotheses that might better reconcile the current classification of these two families and the possible relationship of both to the Pteromalidae.

Biology. Although extensive host records exist for Torymidae, the exact biological relationship between parasite and host has seldom been determined. Both entomophagous and phytophagous torymids are known. The entomophagous forms are either solitary or gregarious ectoparasitic idiobionts. Many species are reared from gall-forming insects including Cynipidae, Tanaostigmatidae, Eurytomidae, Cecidomyiidae, Tephritidae, and Psyllidae. Other species are reared from insect larvae and pupae in protected places such as seed pods, plant stems, and solitary wasp and bee nests; hosts include Coleoptera, Hymenoptera, Diptera, Lepidoptera, and even Strepsiptera. In the Nearctic region a few species parasitize insect eggs. Species of *Podagrion* are reared exclusively from egg cases of Mantidae and *Torymus oviperditor* (Gahan) parasitizes eggs of Cicadidae.

In the Nearctic region, species of *Megastigmus* are believed to be exclusively phytophagous, each larva feeding within a single seed of its host plant. Species have been reared from the seeds of gymnosperms (Pinaceae, Taxoidaceae, Cupressaceae) and angiosperms (Rosaceae, introduced Anacardiaceae, and Aquifoliaceae). Only three other Nearctic torymids are known to be phytophagous: *Torymus rugglesi* Milliron (seeds of *Ilex*), *T. varians* (Walker) (seeds of *Crataegus*), and *T. druparum* Boheman (seeds of *Malus*, *Pyrus*, and *Sorbus*). Although *T. druparum* has been considered a synonym of *T. varians* (Eady 1959, Grissell 1979), Bouček and Graham (1978) consider that the two are distinct species. This information was not incorporated into Grissell (1979).

A few species of Torymidae are reported to eat both plant and insect tissue. For example, *Torymus aea* (Walker) and *T. aucupariae* (Rodzianko) each develop on *Megastigmus* larvae; the former in *Amelanchier* seeds and the latter in *Sorbus* seeds, and they also eat plant tissue surrounding the larva. Considering the common association of torymids with gall-forming or plant-inhabiting hosts, this habit of facultative omnivory is probably much more common than is presently recognized.

Fauna. About 875 species and 65 genera are known from all zoogeographic regions. The majority of species are associated with the temperate fauna of the Holarctic region. Approximately 200 species in 21 genera are found in the Nearctic Region. Only two genera are endemic to this area: *Erimerus* and *Zdenekius*.

Literature. Earlier keys to subfamilies and genera (e.g., Crawford 1914, Szelényi 1957) are now obsolete. Milliron (1949) provided a key to the world genera of Megastigminae which is nearly complete when used in conjunction with Bouček's (1988) work on the Australasian fauna. Grissell (1995) gave a key to world genera of Toryminae (excluding Torymini) and provided a world catalog of species, including host and biological information. In the Nearctic, the tribe Podagrionini was revised by Grissell and Goodpasture (1981).

Use of key. Genera are placed to tribe following Grissell (1995), except for *Cryptopristus*, *Glyphomerus*, and *Zaglyptonotus*, which are unplaced to tribe.

Key to genera of Torymidae

1 Forewing with stigma higher than broad (Fig. 25) and subequal to or higher than costal cell, and with postmarginal vein at least subequal in length to marginal vein (Fig. 25); pronotal collar always elongate (Fig. 7); habitus (Fig. 1) .... MEGASTIGMINAE, ***Megastigmus*** Dalman

Key: Milliron (1949). **Fauna**: 25 spp., in southern Canada and widespread in USA and northern Mexico; world, about another 100 spp. in Palearctic, Afrotropical, Oriental, and Australian regions. **Hosts**: phytophagous in seeds of conifers, Rosaceae, *Ilex* (Aquifoliaceae), and introduced *Pistacia* and *Schinus* (Anacardiaceae).

– Forewing with stigma broader than high and shorter than height of costal cell (Figs. 28, 30), and with postmarginal vein shorter than marginal vein (Figs. 27–31); pronotal collar usually transverse (Fig. 8), rarely elongate (Fig. 9) .... TORYMINAE, 2

2(1) Metafemur enlarged and ventrally with row of teeth (Fig. 43) or at least with 3 or 4 very large teeth (Fig. 44); metatibia curved with apex obliquely truncate, produced ventrally as acute angle; metatibia with 1 spur (Fig. 43) .... Podagrionini, 3

– Metafemur slender, either without ventral teeth (Fig. 56) or with 1 (Figs. 54, 55) or 2 (Fig. 47) large teeth or, sometimes, metafemur finely serrate (Fig. 52); metatibia straight (Figs. 45, 46) or slightly curved (Fig. 47), with apex truncate; metatibia usually with 2 (Fig. 48), but rarely with 1 spur (Fig. 51) 4

3(2) Flagellum with anellus transverse (Fig. 41); forewing partially bare basally and with speculum behind parastigma; metasternum with single, median carina between foramina of metacoxae (Fig. 24); habitus (Fig. 4) .... ***Podagrion*** Spinola

Key: Grissell and Goodpasture (1981). **Fauna**: 6 spp., in southern half of USA to South America; world, another 91 spp. **Hosts**: in egg cases of Mantidae.

– Flagellum with anellus quadrate to elongate (Fig. 42); forewing completely covered with setae basally, without speculum; metasternum with 2 irregular or broken submedian carinae between foramina of metacoxae (Fig. 23) .... ***Palmon*** Dalman

Key: Grissell and Goodpasture (1981) (as *Pachytomoides* Girault, see Grissell 1995). **Fauna**: 1 sp., *P. zygas* (Grissell and Goodpasture), in USA (FL); world, another 17 spp. in Afrotropical, Oriental, Australian, and Neotropical regions. **Hosts**: in egg cases of Mantidae.

4(2) Metapleuron separated by sinuous line from mesopleuron, the metapleuron projecting forward into mesopleuron (Fig. 6) .... Torymini, 5

– Metapleuron separated by straight line from mesopleuron, not projecting forward (Fig. 5) 8

5(4) Metafemur with 2 primary ventral teeth (Fig. 47) and sometimes small additional teeth .... ***Physothorax*** Mayr

Note: males of *P. pallidus* Ashmead are wingless and are included in the key to genera of Agaonidae (chapter 4).

Keys: Burks (1969) and Boucek (1993). **Fauna**: 3 spp. in USA (FL); world, another 6 spp. in Neotropical region. **Hosts**: in fig galls caused by *Ficiomyia perarticulata* Felt (Cecidomyiidae) or Agaonidae.

– Metafemur with at most 1 tooth (as in Fig. 55), normally without teeth (as in Fig. 56) 6

6(5) Forewing with marginal vein at most 4 times as long as stigmal vein (Fig. 28); propodeum heavily carinate; propodeal spiracle in deep basin encircled by strong carina (Fig. 11) **and** metafemur with enlarged tooth (as in Fig. 55) .... ***Diomorus*** Walker

Fauna: 2 spp., *D. zabriskii* Cresson and *D. viridis* (Provancher), in western Canada and transcontinental in USA; world, another 12 spp. in Oriental, Afrotropical, Palearctic, and Neotropical regions. **Hosts**: wasps and bees (Aculeata).

– Forewing with marginal vein at least 7 times as long as stigmal vein (as in Figs. 29, 30); propodeum usually without carinae (Fig. 10), at most with a few irregular carinae and with spiracle never encircled by carina; metafemur rarely with tooth 7

7(6) Pronotal collar in dorsal view elongate (Fig. 9) .... ***Allotorymus*** Huber

Note: likely just a modified species of *Torymus*.

Fauna: 1 sp., *A. splendens* (Provancher), widespread in Canada (BC to ON), and in USA (CO).

– Pronotal collar in dorsal view transverse (Fig. 8); habitus (Fig. 3) .... ***Torymus*** Dalman

Keys: Huber (1927) and Grissell (1976) (in part). **Fauna**: 99 spp., widespread in Canada, USA, and Mexico; world, another 224 spp., primarily in Holarctic region, a few spp. in Neotropical, Afrotropical, Oriental, and Australian regions. **Hosts**: commonly associated with gall-forming Cynipidae on *Quercus* and *Rosa*, and Cecidomyiidae on many plants, uncommonly associated with other insect groups; several spp. phytophagous.

8(4) Metatibia with spurs much longer than width of metatibial apex (Fig. 45) .... ***Zaglyptonotus*** Crawford

Fauna: 2 spp.; *Z. mississippiensis* Breland and *Z. schwarzi* Crawford, widespread but uncommon in USA; world, 1 other sp., *Z. bruchi* (Girault) in Neotropical region, and several undescribed spp. in South America. **Hosts**: associated with Tephritidae in Asteraceae.

– Metatibia with spurs scarcely longer than width of metatibial apex (Figs. 46, 48) 9

9(8) Head with occipital carina (Fig. 18) well developed and closer to occipital foramen than to posterior ocelli, the carina dorsally not arched, nearly horizontal (apparent in dorsal view), and ventrally reaching hypostomal carina (head usually must be removed to see this); metafemur ventrally with abrupt tooth (Fig. 55); metasoma with posterior margin of Mt_2 not emarginate .... Monodontomerini, 10

– Head with occipital carina absent or weakly developed (Fig. 20) or, if apparent, carina medially arched and **either** midway between occipital foramen and posterior ocelli **or** closer to ocelli (as in Fig. 19) and then ventrally not reaching hypostomal carina (often can be seen without removing head); metafemur ventrally either without tooth (as in Fig. 56), or angulate (Fig. 53), or vaguely serrate (Figs. 52, 48); metasoma with posterior margin of Mt_2 emarginate or not 11

10(9) Scutellum with frenal line barely perceptible; metafemur somewhat swollen, with tooth nearer middle than apex (Fig. 54); hypopygium prominent, broadly plough-shaped (Fig. 58); ovipositor sheaths curved sharply upward, not projecting beyond apex of metasoma, with stylets frequently protruding as short, straight barb (Fig. 58); habitus (Fig. 2) .... ***Zdenekius*** Grissell

Fauna: 1 sp., *Z. smithi* Grissell, widespread but uncommon in southern Canada and northern USA. **Hosts**: associated with Aculeata and/or their parasites in twigs.

– Scutellum with frenal line well defined; metafemur with subapical tooth (Fig. 55); hypopygium, if visible, pointed (Fig. 57); ovipositor sheaths projecting well beyond apex of metasoma and usually covering stylets (Fig. 57) .... ***Monodontomerus*** Westwood

Key: Gahan (1941). **Fauna**: 13 spp. (several undescribed), widespread in Canada, USA, and Mexico; world, another 19 spp. in Palearctic, Neotropical, and Oriental regions. **Hosts**: associated with many families of Lepidoptera, Diptera (Tachinidae), and Hymenoptera (Symphyta and solitary Aculeata, especially Megachilidae, Anthophoridae, Sphecidae, and Vespidae).

11(9) Forewing with marginal vein at least 7 times as long as stigmal vein and more than 3 times as long as postmarginal vein (Fig. 29).. Torymoidini, 12

– Forewing with marginal vein at most 5 times as long as stigmal vein and less than 3 times as long as postmarginal vein (Fig. 31).. 14

12(11) Flagellum with 1 anellus (Fig. 37) .... ***Pseudotorymus*** Masi

Fauna: 1 described sp., *P. lazulellus* (Ashmead), and several undescribed spp., widespread in southern Canada and northern USA; world, another 42 spp. in Palearctic and Afrotropical regions. **Hosts**: uncertain, but reported from Eurytomidae and Cecidomyiidae in USA; Old World species associated with Coleoptera, Diptera (Cecidomyiidae), Hymenoptera (Eurytomidae, Cynipidae, Tenthredinidae), and Lepidoptera (Pyralidae).

– Flagellum with at least 2 anelli (Fig. 40).. 13

13(12) Metatibia with spurs modified as elongate, polished, apically black spines (Fig. 50), differing from protibial and mesotibial spurs, these covered with short bristles .... ***Platykula*** Huber

Fauna: 1 sp., *P. albihirta* (Ashmead), in eastern USA (see Grissell 1992); world, several undescribed spp. in Neotropical region.

– Metatibia with spurs unmodified, all tibial spurs covered with short bristles (bristles visible at 100X but at lower magnification giving spurs a fuzzy appearance, Fig. 49) .... ***Torymoides*** Walker

Fauna: 2 described and several undescribed spp., transcontinental in USA; world, another 46 spp. in all regions. **Hosts**: associated with Cecidomyiidae in USA (extralimital species from galls, especially Diptera).

14(11) Head with occipital carina visible as distinct arch (as in Fig. 19) **and** metafemur with ventral margin concave subapically and angulate basal to concavity (Figs. 46, 53) 15

– Head either without occipital carina or, if present, carina weak (Fig. 20) and metafemur with ventral margin convex subapically (Figs. 48, 52) and sometimes serrate (Fig. 52) .... Microdontomerini, 16

15(14) Metafemur with ventral margin sharply angulate subapically (Fig. 53). *Female*: Mt_2 and Mt_3 oblong, and Mt_2 with posterior margin deeply excised (Fig. 59). *Male*: Mt_2 transverse, with posterior margin entire .... ***Cryptopristus*** Förster

Fauna: 1 sp., *C. harrisii* (Fitch), widespread in eastern USA, possibly introduced from Europe; world, 1 other sp., *C. caliginosus* (Walker), in Palearctic region. **Hosts**: associated with Eurytomidae in grass nodes.

– Metafemur with ventral margin at most slightly angulate and serrate subapically (Fig. 46). *Both sexes*: Mt_2 and Mt_3 transverse, with posterior margins entire (Fig. 60) .... ***Glyphomerus*** Förster

Fauna: 1 sp., *G. stigma* (Fabricius), transcontinental across southern Canada and entire USA, possibly introduced from Europe; world, another 4 spp. in Palearctic region. **Hosts**: reared from mossyrose gall wasp, *Diplolepis rosae* (*L.*) (Cynipidae), on *Rosa*.

16(14) Metatibia with 1 apical spur (Fig. 51). *Male*: eye reduced (Fig. 22).. 17

– Metatibia with 2 apical spurs (Fig. 48) (outer spur sometimes difficult to see in specimens less than 1 mm long). *Male*: eye normal (Fig. 21) 18

17(16) *Female*: clava with terminal spine (Fig. 32). *Both sexes*: flagellum with anellus wider than long and funicle with basal 5 segments somewhat ring-like (i.e., much wider than long) (Fig. 32) .... ***Pseuderimerus*** Gahan

Fauna: 3 described and at least 6 undescribed spp. in western USA; world, another 5 described spp. in Palearctic region. **Hosts**: Cecidomyiidae in wheat stems (probably associated with other grasses as well).

– *Female*: clava without terminal spine (Fig. 34). *Both sexes*: antenna with anellus quadrate to longer than broad and funicle with basal segments not reduced (Fig. 34) .... ***Erimerus*** Crawford

Fauna: 1 described sp., *E. wickhami* (Ashmead) in USA (UT), and 1 undescribed sp. **Hosts**: from stem galls, probably of *Tetramesa* (Eurytomidae), in grasses.

18(16) Metafemur with ventral margin minutely serrate (Fig. 52), the teeth sometimes produced as slender, sharp barbs (difficult to see except at 50–100X); propodeum with 2 complete submedian carinae (Fig. 13) 19

– Metafemur with ventral margin not serrate (Fig. 48), though margin sometimes wavy; propodeum either without carinae, or with median carina (Fig. 12), or with several irregular, incomplete carinae 20

19(18) Flagellum with 2 or 3 anelli (Fig. 38); funicle much wider apically than basally, with segments closely appressed (Fig. 38). *Male*: clava and apical 2 funicular segments with ventrolateral micropilose area (Fig. 36) (flagellum in lateral view with apical half diagonally truncated, Fig. 35) .... ***Eridontomerus*** Crawford

Fauna: 1 sp., *E. isosomatis* (Riley), transcontinental in USA, possibly introduced from Europe; world, another 11 spp. in Palearctic region. **Hosts**: associated with gall-forming Eurytomidae and Cecidomyiidae in grass stems.

– Flagellum with 1 anellus (Fig. 33); funicle about as broad apically as basally, with segments often somewhat separated (Fig. 33). *Male*: clava and funicular segments without micropilose area (flagellum in lateral view with apical half cylindrical) .... ***Ditropinotus*** Crawford

Fauna: 1 sp., *D. aureoviridis* Crawford, transcontinental in USA, possibly introduced from Europe; world, 1 other sp., *D. obscurus* Nikol'skaya, in Palearctic region. **Hosts**: associated with gall-forming Eurytomidae and Cecidomyiidae in grass stems.

20(18) Flagellum with 1 anellus (as in Fig. 33) .... ***Microdontomerus*** Crawford

Fauna: 4 described and about 6 undescribed spp., transcontinental in USA; world, another 4 spp. in Palearctic and Afrotropical regions. **Hosts**: primary and secondary parasites of Lepidoptera, Coleoptera, Diptera, and Aculeata (Hymenoptera) and their parasites (Braconidae).

– Flagellum with at least 2 anelli (Fig. 39) .... ***Idiomacromerus*** Crawford

Fauna: 4 spp., widespread in region; world, another 22 spp. in Palearctic, Neotropical, Australian (introduced), and Afrotropical regions. **Hosts**: Nearctic species associated with Eurytomidae in seeds, extralimital species associated with Cecidomyiidae, Cynipidae, and Strepsiptera.

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MEGASTIGMINAE 1
Megastigmus Dalman 1
Microdontomerini 14
Microdontomerus Crawford 20
Monodontomerini 9
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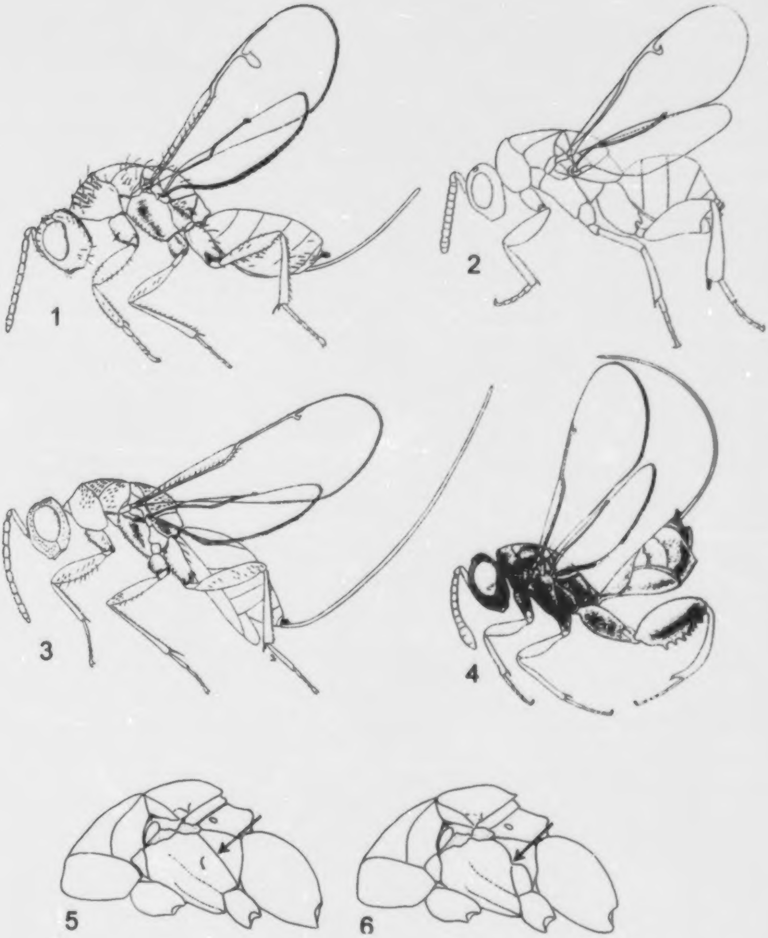

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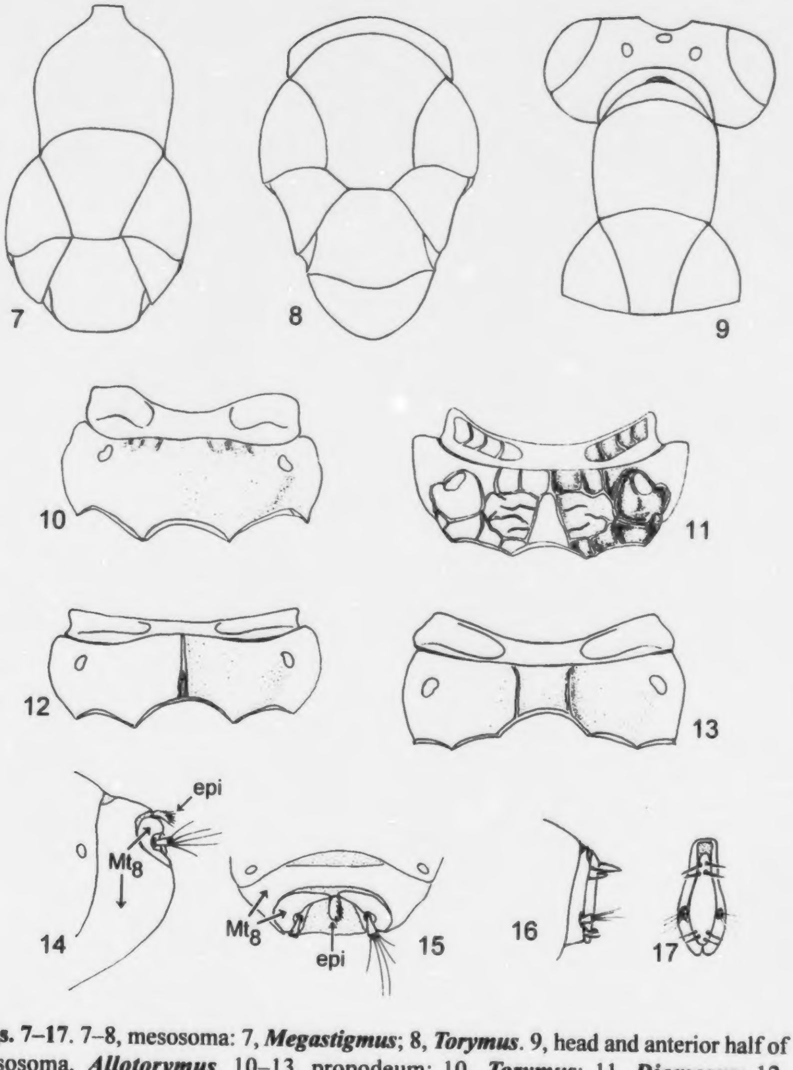
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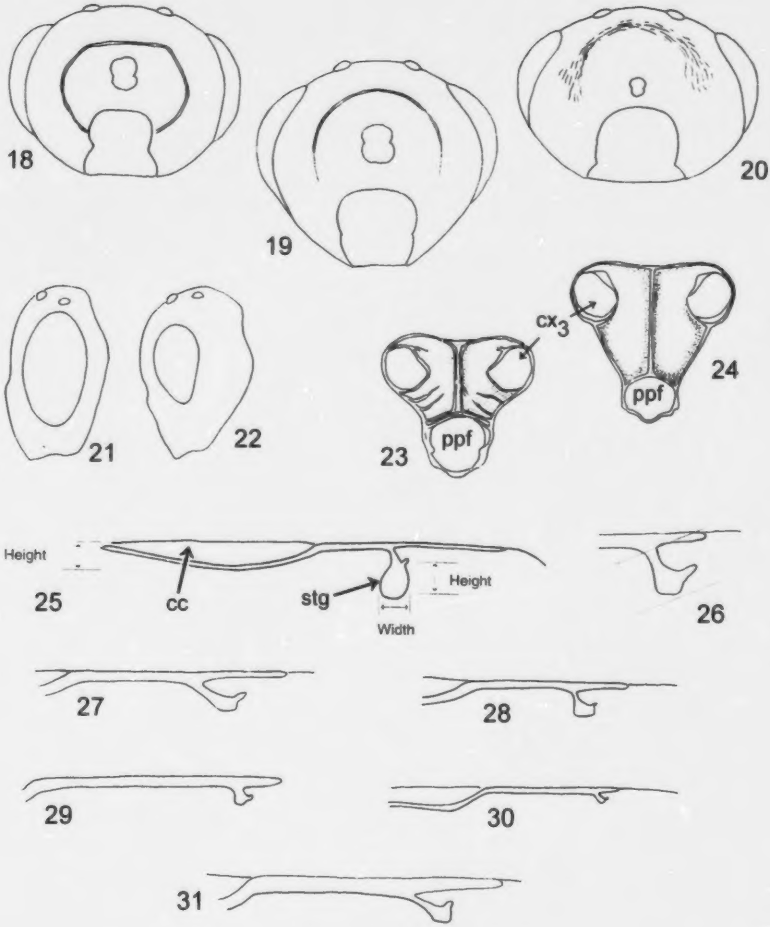
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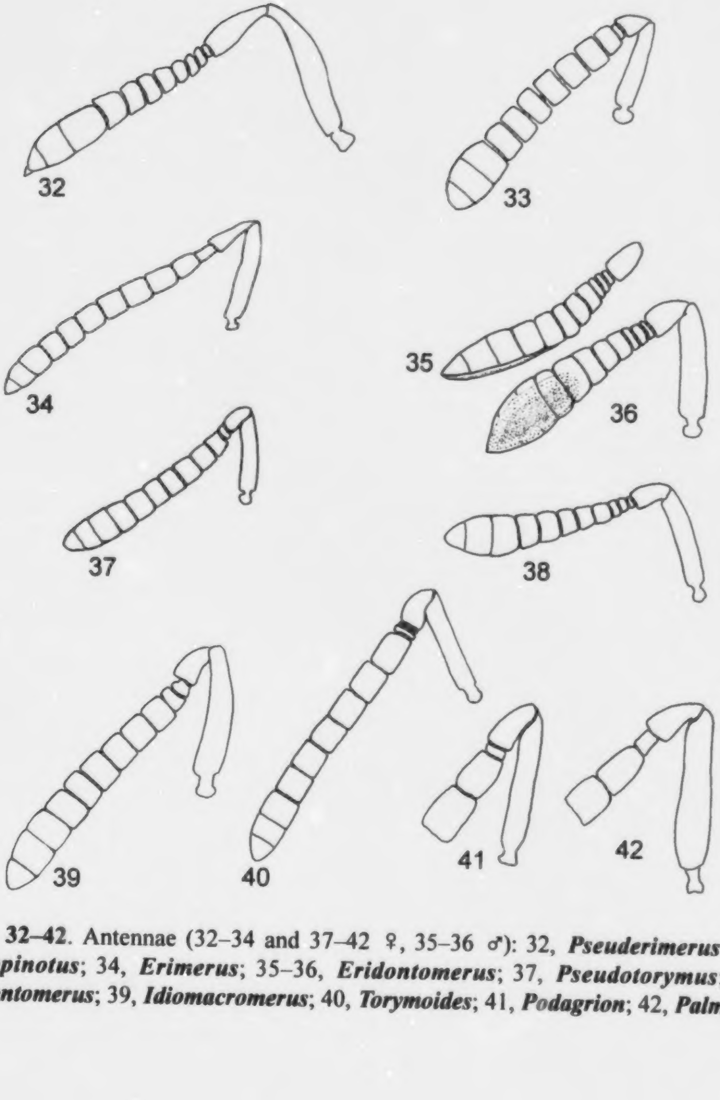
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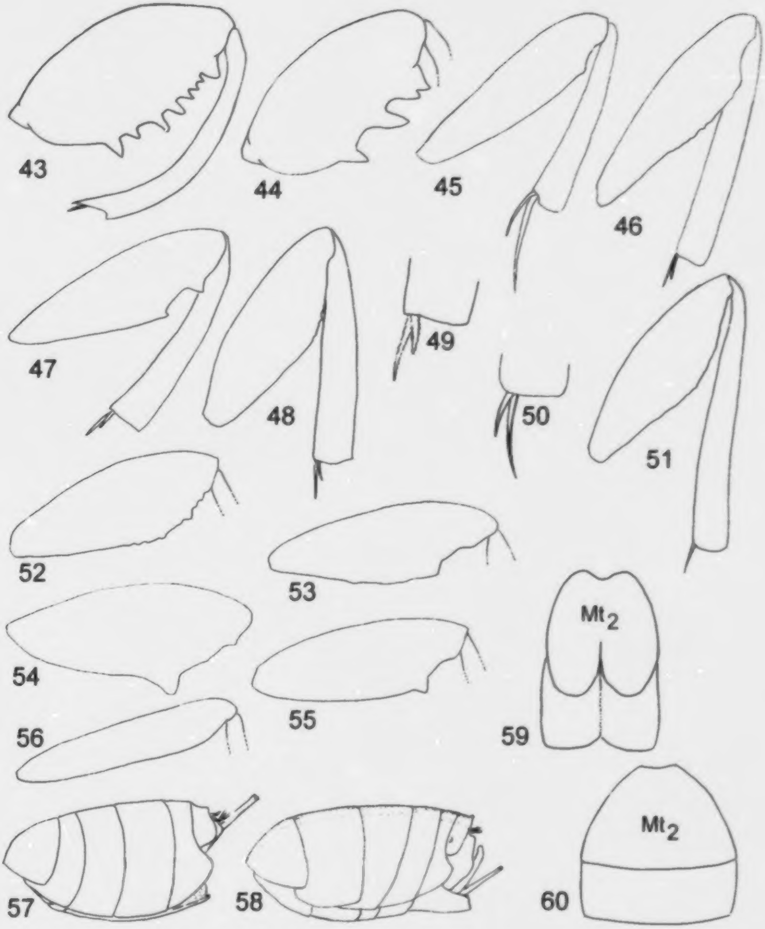
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Chapter 22. **TRICHOGRAMMATIDAE**

John D. Pinto

Recognition. Trichogrammatidae are among the smallest of insects, ranging in size from 0.2–1.5 mm. They are distinguished from other Chalcidoidea by their 3-segmented tarsi (Fig. 4). Other important features that help to distinguish trichogrammatids include: body shape compact, less commonly elongate, but always without a distinct constriction between mesosoma and metasoma; body light yellow to dark brown, often a combination of both, less commonly orange or red, almost never metallic; cuticle smooth, rarely moderately sculptured (Figs. 8–10); flagellum (Figs. 3, 13–37) with 2–9 (usually 3–7) segments, including 1 or 2 anelli (rarely 3), 0–2 funicular segments, and 1–5 claval segments; antenna sexually dimorphic in several genera (cf. Figs. 15 and 16, 19 and 20, 28 and 29, 33 and 34); toruli at lower margin of eye (Fig. 2); pronotum short, not obvious from above; forewing varying from extremely narrow and strap-like (Fig. 52), to very broad and slightly rounded apically (Fig. 38), occasionally wingless or shortwinged; venation (Fig. 1) relatively short, not extending much beyond apical half of wing; postmarginal vein almost always absent (extremely short if present); distribution of discal setae in both forewing and hind wing variable (Figs. 38–52, 69–70), but commonly arranged into distinct lines.

Biology. Trichogrammatidae are solitary or gregarious, primary endoparasites of insect eggs. Certain genera such as *Trichogramma* are known to parasitize eggs of several insect orders. Other genera are apparently restricted to a single order. The eggs of auchenorrhynchous Homoptera are parasitized by the largest number of genera (e.g., *Ufens*, *Paracentrobia*, and *Aphelinoidea*). Several genera are also reported from Coleoptera, Hemiptera, and Lepidoptera. Most trichogrammatids parasitize eggs placed on or in plant tissues. Two genera, *Hydrophylita* and *Prestwichia*, parasitize eggs of aquatic insects and have been reported to swim underwater to search for hosts. Representatives of certain groups such as *Brachista* are phoretic on adult insects; this presumably facilitates access to host eggs. An exception to egg parasitism is a record by Viggiani (1981*a*) of an *Oligosita* from puparia of the Hessian fly, *Mayetiola destructor* (Say).

A few genera of Trichogrammatidae are of interest for biological control. *Trichogramma* has received the most attention from applied entomology because its members parasitize numerous pest Lepidoptera and can be mass propagated and released with relative ease. *Trichogramma*, with about 30 named species in the Nearctic region, has been the world's most widely used arthropod for augmentative control programs (King et al. 1985, Smith 1996). Sugarcane borer (*Diatraea saccharalis* Fabricius), European corn borer (*Ostrinia nubilalis* Hübner), codling moth (*Cydia pomonella* L.), and spruce budworm (*Choristoneura fumiferana* Clemens) are among the crop pests against which *Trichogramma* has been used.

Fauna. The family Trichogrammatidae consists of about 600 species in 80 genera worldwide. The family is cosmopolitan in distribution, as are many of its genera. As far as known, representatives occur in all vegetated terrestrial habitats. With the possible exception of *Ittysella* and *Brachyufens*, none of the recorded genera is restricted to the Nearctic region. Six genera, however, are recorded only from the New World (*Lathrogramma*, *Brachista*, *Pintoa*, *Trichogrammatomyia*, *Xenufens*, and *Zagella*). It is premature to speculate on relative habitat diversity. However, limited collections in the Nearctic region suggest that generic and species diversity is greater east of the Rocky Mountains and is perhaps greatest in the southeastern United States.

The family has been inadequately sampled throughout the world and collections required for comprehensive revisionary studies do not yet exist. Consequently, with few exceptions, most material cannot be confidently identified to species. Although the Nearctic region apparently contains few if any endemic genera, endemicity at the species level may be considerable. Several genera such as *Zagella*, *Chaetostricha*, *Paracentrobia*, and *Mirufens* are represented by virtually undescribed faunas. To a lesser extent this problem even extends to *Trichogramma*, a genus of considerable importance to applied entomology. The poorly understood Nearctic fauna is exemplified by relatively recent publications by Burks (1979) and Yousuf and Shafee (1987), which report only 17 trichogrammatid genera in America north of Mexico and 19 in the Nearctic region, respectively. Collecting during the past decade quickly increased the number of Nearctic genera to 35. Only 75 Nearctic species have been named; 30 of these belong to a single genus, *Trichogramma*. The large number of *Trichogramma* reflects taxonomic interest because of applied concerns. *Oligosita*, *Paracentrobia*, and *Aphelinoidea* are usually more common than other genera in collections. The most frequently collected genus throughout the world is *Oligosita*.

Literature. The most comprehensive taxonomic work on the Trichogrammatidae is by Doutt and Viggiani (1968). This monograph remains useful for its key to genera of the world, diagnoses and illustrations based on type species, generic synonymies, and species listings. Other important taxonomic publications include a classification of the family stressing male genitalia (Viggiani 1971), a catalog of genus-group names (Yousuf and Shafee 1986*a*), and a species checklist (Yousuf and Shafee 1986*b*).

Use of key. Because of the poorly understood fauna, generic concepts remain tentative in the family. This must be kept in mind when using the generic key. Currently, 30 of the 80 world genera are monotypic and 25 others contain 5 or fewer species. Only 14 genera have more than 10 species. Because several genera contain numerous undescribed species, current generic definitions reflect an underappreciation of total diversity. As new species are discovered, previously defined phenetic gaps are narrowing. The key attempts to take this into consideration where possible. However, the separation of certain groups, namely, *Zagella* from *Chaetostricha*, *Zaga* from *Lathrogramma*, and *Ittys* from *Paracentrobia*, remain problematic.

The key is intended for both sexes but females will present fewer difficulties. Being based on the Nearctic fauna, the key includes only half of the genera in the family and has been tested primarily against Nearctic species. Extralimital species may not key correctly. Because of their size and fragility, slide mounted specimens viewed under a compound microscope are required for observing most of the characters used in the key. For best results specimens should be cleared and then mounted, preferably in Canada balsam. Dorsoventral mounts are recommended for optimum viewing especially of the genitalia. Wings should either be spread at right angles to the body or mounted separately. The key uses the terminology of Doutt and Viggiani (1968) for venation and setal lines on the forewing (Fig. 1), except that the term parastigma is used for what is called the premarginal vein in previous literature on Trichogrammatidae. Names of setal lines (Rs_1, Rs_2, and R) correspond to veins occurring in a similar position in a more primitive Hymenoptera wing. Homology to those veins is not implied.

Many of the couplets use antennal characters. Distinguishing the anelli, funicle, and clava is essential for identifying trichogrammatids. In a few groups the flattened, disk-like anelli are similar in size and shape to the basal-most funicular or claval segment. These segments can be identified by the capitate peg sensilla, which are absent from the anelli (Figs. 3, 11: cps). The funicle and clava are distinguished by their relatively narrow connection between them (more or less at the center of the connecting segments only), whereas funicular and claval segments are typically broadly appressed, joined to each other across their entire breadth. Knowing the maximum and minimum number of funicular and claval segments can also help in distinguishing them. The number of postanellar segments rarely exceeds 5 [male *Ufens* and *Mirufens* with 6 segments are exceptions (Fig. 28)]; the number of funicular segments varies from 0–2, and the number of claval segments from 1–5. Thus, if the funicle has 2 segments, the clava has no more than 3 segments (except 4 in male *Ufens* and *Mirufens*). Because in certain genera the flagellar segments are considerably asymmetrical, care must be exercised to avoid inadvertently counting the same suture twice while focusing through the antenna. The basal-most funicular or claval segment is sometimes very short, closely appressed to the next segment, and consequently difficult to discern [e.g., in *Zagella* (first funicular, Fig. 31), *Zaga* and *Lathrogramma* (first claval, Fig. 13)]. These segments also are often asymmetrically positioned and usually only visible on one surface. Anticipating this problem, *Zaga* and *Lathrogramma* should key regardless of which choice is taken at couplet 3.

Key to genera of Trichogrammatidae

1 Wingless or, if short winged, forewing not approaching apex of metasoma when folded on dorsum 44

– Fully winged, forewing approaching or surpassing apex of metasoma when folded on dorsum 2

2(1) Flagellum without funicle, consisting only of anellus and clava (Figs. 13–19) 3

– Flagellum with 1 or 2 funicular segments between anellus and clava (Figs. 20–37) 16

3(2) Clava 5-segmented (first segment sometimes very small and appressed to second segment) (Figs. 13–16) 4

– Clava with fewer than 5 segments or at least apparently so (Figs. 17–37) 10

4(3) *Male*: stigmal vein short, not distinct from marginal vein (Fig. 65), and forewing densely setose, without distinct setal lines in posterior two-thirds (Fig. 48) .... ***Tumidiclava*** Girault (males, in part), see 15

– *Both sexes*: stigmal vein longer, distinct from marginal vein (e.g., Figs. 53–58), and forewing setation variable but usually with distinct setal lines throughout (Figs. 38-43) 5

5(4) Maxillary palpus 2-segmented (Fig. 5). *Female*: clava with elongate longitudinal sensilla extending well beyond segment surface (Fig. 16). *Male*: clava with elongate, thick, seta-like longitudinal sensilla, the sensilla 3 to 4 times as long as maximum breadth of clava (Fig. 15); aedeagus extremely long, extending well anterior to base of genital capsule (Fig. 73) .... ***Haeckeliania*** Girault

Fauna: several undescribed spp., widespread but most common in southeast USA and Mexico; world, 6 spp.

– Maxillary palpus 1-segmented (Figs. 6, 7); clava without such elongate longitudinal sensilla. *Male*: genitalia either without distinct aedeagus or, if present, aedeagus not extending anterior to base of genital capsule (Figs. 72, 74–76) 6

6(5) *Female*: clava with terminal rod-like projection (Fig. 14). *Male*: genitalia with aedeagus distinct from genital capsule (as in Fig. 74) .... ***Lathromeris*** Förster

Fauna: at least 1 unidentified sp., known from several widely scattered localities in Canada and USA; world, 17 spp. **Hosts**: Lepidoptera (Risbec 1956).

– *Female*: clava without terminal rod-like projection. *Male*: genitalia with aedeagus entirely fused to genital capsule, not distinct (as in Fig. 76) 7

7(6) Forewing with setal lines conspicuously converging near apex of retinaculum (Fig. 42) .... ***Lathromeroidea*** Girault

Fauna: 1 described sp., *L. odonatae* (Ashmead), and several undescribed spp., in western Canada and eastern USA; world, 7 spp. **Hosts**: Odonata, aquatic Hemiptera (Henriquez and Spence 1993) and Homoptera.

– Forewing with setal lines not obviously converging near apex of retinaculum 8

8(7) Forewing broad, with longest marginal setae less than 0.15 times maximum breadth of wing (as in Fig. 38); marginal vein short and broad 9

– Forewing narrower, with longest marginal setae at least 0.20 times maximum breadth of wing; marginal vein more elongate, narrower (as in Figs. 40, 43) .... ***Pterygogramma*** Girault

Fauna: at least 1 unidentified sp., questionably assigned; world, 6 spp. **Hosts**: Homoptera (Girault 1938).

9(8) Body at least 1 mm long; body yellow, boldly marked with black; ovipositor longer than metasoma .... ***Zaga*** Girault (part)

Note: *Zaga* erroneously treated as synonym of *Uscana* by Yousuf and Shafee (1987). *Uscanoidea marylandica* (Girault) also keys here; it cannot currently be separated at the generic level.

Fauna: 1 apparently widespread sp., *Z. latipennis* Girault; world, 2 spp. **Hosts**: Homoptera.

– Body less than 1 mm long; body color variable; ovipositor subequal to or, more commonly, distinctly shorter than metasoma .... ***Lathrogramma*** De Santis (part)

Note: questionably distinct from *Zaga*.

Fauna: several undescribed spp., widespread; world, 1 described sp. **Hosts**: Homoptera.

10(3) Clava with at least 4 segments (Fig.17); forewing with distinct stigmal vein 11

– Clava with fewer than 4 segments or, if rarely with 4 segments, forewing with obsolescent stigmal vein (as in Figs. 64, 65)........ 14

11(10) Forewing without Rs_1. *Female*: apex of metasoma with elongate, ventrolateral, strap-like apodemes extending anteriorly from near base of ovipositor (Fig. 77) .... ***Brachista*** Walker

Key: Pinto (1994). **Fauna**: 2 spp., in eastern USA, western USA south of latitude 35° N, and Mexico; world, 3 spp. **Hosts**: Coleoptera and Homoptera (Webster 1894, Marlatt 1898); 2 spp. phoretic on Asilidae.

– Forewing with Rs_1. *Female*: apex of metasoma without apodemes at base of ovipositor 12

12(11) Forewing with stigmal vein narrower at base than at apex (as in Fig. 53) and with marginal vein longer than parastigma; protibia dorsally without prominent spine; ovipositor distinctly shorter than metasoma; clava 4-segmented .... ***Uscana*** Girault

Note: a few species keying here may represent a distinct genus.

Fauna: 2 spp., widespread; world, 17 spp. (see Fursov 1987). **Hosts**: Bruchidae and Buprestidae.

– Forewing with stigmal vein not narrower at base than at apex (Fig. 59) and with marginal vein either subequal in length to parastigma or distinctly shorter; protibia dorsally with prominent spine (as in Fig. 71); ovipositor variable in length; clava 5-segmented, but first segment very short, closely appressed to second segment, and usually difficult to see (Fig. 13) 13

13(12) Body at least 1 mm long; body yellow, boldly marked with black; ovipositor longer than metasoma .... ***Zaga*** Girault, see 9

– Body less than 1 mm long; body color varied; ovipositor subequal to or, more commonly, distinctly shorter than metasoma .... ***Lathrogramma*** De Santis, see 9

14(10) *Male*: clava without distinct segments (Fig. 19); forewing with venation sigmoid, the stigmal vein elongate (Fig. 62); forewing with distinct setal lines (Fig. 39) .... ***Trichogramma*** Westwood (part)

Key: Sorokina (1993) (for taxonomy see Pinto et al. 1978, Pinto and Oatman 1985, and Zerova and Fursov 1989). **Fauna**: 30 described and several undescribed spp., widespread; world, about 160 spp. **Hosts**: several insect orders, primarily Lepidoptera.

– *Both sexes*: clava with at least 2 distinct segments; forewing venation not sigmoid, the stigmal vein short, sessile (Fig. 64); forewing densely setose, without distinct setal lines in posterior two-thirds (Figs. 48–50) 15

15(14) *Both sexes*: clava 2- or 3-segmented, without terminal rod-like projection (Fig. 18); forewing with dense discal setae, without distinct setal lines (Figs. 49, 50); hind wing with at least 3 complete setal lines (Fig. 69)................................... ***Aphelinoidea*** Girault

Key: Trjapitzin (1995). **Fauna**: 3 spp., widespread; world, 32 spp. **Hosts**: Coleoptera and Homoptera.

– *Female*: clava 3-segmented and with terminal rod-like projection (as in Fig. 14). *Male*: clava 3- or 5-segmented. *Both sexes*: forewing with sparser discal setae, at least R and Rs_2 distinct, well separated, and with few if any setae between them (Fig. 48); hind wing with only 2 complete setal lines, the third (posterior) line absent at least in basal half (Fig. 70) .... ***Tumidiclava*** Girault

Fauna: 1 described sp., *T. pulchrinotum* Girault, and other undescribed spp., widespread; world, 16 spp. **Hosts**: Coleoptera and Orthoptera.

16(2) Forewing narrow, pointed apically, narrowing from venation to apex (Fig. 52); flagellum with 2 distinct funicular segments (Fig. 23) .... ***Hydrophylita*** Ghesquière

Fauna: 1 sp., *H. aquivolans* (Matheson & Crosby), in eastern Canada and USA; world, 3 spp. **Hosts**: Odonata.

– Forewing variable, but not narrowing from venation to apex, at least slightly broader in apical quarter than at level of venation; flagellum with 1 or 2 funicular segments 17

17(16) Funicle 1-segmented (Figs. 32–37); forewing narrow, 2.5–8 times as long as broad, and disc without distinct setal lines, often with relatively few setae; marginal setae at least one-third as long as greatest breadth of wing (Figs. 45–47, 51); midlobe of mesoscutum and scutellum each almost always with 1 pair of setae (Fig. 8).. 18

– Funicle 1- or 2-segmented; forewing variable but if funicle 1-segmented then forewing broad (as in Fig. 41), less than 2.5 times as long as broad and with marginal setae less than one-third as long as greatest breadth of wing; midlobe of mesoscutum and scutellum each with 2 pairs of setae (Figs. 9, 10) 24

18(17) Forewing extremely narrow (5–8 times as long as broad), with marginal setae 2–5 times as long as greatest breadth of wing or, if wing somewhat broader (about 4 times as long as broad), funicle closely associated with clava and scape and pedicel combined longer than flagellum 19

– Forewing not as narrow (2.5–4 times as long as broad), with marginal setae only slightly longer or, more commonly, shorter than greatest breadth of wing (Figs. 45–47) 20

19(18) Clava 2-segmented; forewing strap-like, with marginal setae about 5 times as long as maximum breadth of wing (Fig. 51).. ***Megaphragma*** Timberlake

Fauna: 1 sp., *M. mymaripenne* Timberlake, probably widespread but currently known primarily from southwestern USA; world, 6 spp. **Hosts**: Thysanoptera.

– Clava 3-segmented; forewing broader, not strap-like, with marginal setae about 2–3 times maximum breadth of wing .... ***Prestwichia*** Lubbock

Fauna: 1 unidentified sp. in USA (FL); world, 4 spp. **Hosts**: Odonata, aquatic Hemiptera, and Coleoptera.

20(18) Clava 1-segmented (Fig. 32) 21

– Clava 2- or 3-segmented (Figs. 33–36) 22

21(20) Forewing with numerous discal setae; metasoma with intersegmental membranes longitudinally striate .... ***Doirania*** Waterston

Fauna: 1 unidentified sp. in eastern Canada and USA; world, 2 spp. (see Yashiro 1980). **Hosts**: Orthoptera.

– Forewing without discal setae (Fig. 47); metasoma with intersegmental membranes not longitudinally striate .... ***Epoligosita*** Girault (part)

Fauna: 1 sp., *E. mexicana* Viggiani (see Pinto and Viggiani 1987), in southwestern USA and northwestern Mexico; world, 15 spp. (see Lin 1990). **Hosts**: Homoptera.

22(20) Flagellum with funicular segment closely associated with clava and with curved longitudinal sensillum (Figs. 33, 34). *Male:* clava with extremely long setae (Fig. 33); genitalia with distinct aedeagal apodemes (as in Fig. 74) .... ***Pintoa*** Viggiani

Fauna: 1 sp., *P. nearctica* Viggiani (1989), in eastern Canada and USA, and Mexico; New World only.

– Flagellum with funicular segment distinct from clava and without longitudinal sensillum (Figs. 35, 36). *Male:* clava without extremely long setae; genitalia simple, without aedeagal apodemes (Fig. 75) 23

23(22) Clava 2-segmented; forewing ovoid, without discal setae (Fig. 47) .. .. ***Epoligosita***, see 21

– Clava 2- or 3-segmented; forewing not ovoid, with few to many discal setae (Figs. 45, 46) .... ***Oligosita*** Walker (part)

Key: Viggiani (1981*b*). **Fauna**: 9 spp., widespread; world, about 110 spp. **Hosts**: Hemiptera, Homoptera, Orthoptera, and Diptera.

24(17) Clava 1-segmented (Figs. 20, 24, 25) 25

– Clava 2–4-segmented (Figs. 21, 22, 26–31) 31

25(24) Stigmal vein obsolescent, consisting of small appendix at apex of marginal vein (Fig. 66) .... ***Paratrichogramma*** Girault

Fauna: 1 sp., *P. californica* Doutt (1973), in southwestern USA and in Mexico; world, 7 spp. **Hosts**: Lepidoptera.

– Stigmal vein more distinct, broader and usually more elongate (Figs. 59, 62, 67, 68) 26

26(25) *Female*: forewing venation sigmoid, the marginal vein curving apically into elongate stigmal vein, the two veins not distinctly distinguished from each other (Fig. 62) 27

– *Both sexes:* forewing venation not sigmoid, the marginal vein ending abruptly at apex and distinguished from stigmal vein (e.g., Figs. 59, 68) 28

27(26) Forewing with Rs_1 setal line represented by at least a few setae (Fig. 39) .... ***Trichogramma***, see 14

– Forewing without Rs_1 .... ***Trichogrammatoidea*** Girault (part)

Key: Nagaraja (1978). **Fauna**: 1 sp., *T. bactrae* Nagaraja, introduced from Australia into southwestern USA (Hutchison et al. 1990); world, 22 spp. **Hosts**: Lepidoptera.

28(26) *Female*: forewing with elongate marginal setae, their maximum length at least half maximum breadth of wing; stigmal vein distinct, constricted at base (Fig. 57) .... ***Trichogrammatomyia*** Girault (part)

Fauna: 1 described sp., *T. tortricis* Girault, and 1 undescribed sp., in eastern USA and in Mexico. **Hosts**: Lepidoptera.

– *Both sexes*: forewing with short marginal setae, their length no more than one-fifth maximum breadth of wing; stigmal vein short and sessile, not constricted at base (Figs. 67, 68) 29

29(28) *Female*: ovipositor extending beyond metasomal apex by at least one-third length of metasoma. *Male:* aedeagal apodemes absent (Fig. 76). *Both sexes:* funicle completely divided into 2 segments (Fig. 24) .... ***Xiphogramma*** Nowicki

Key: Pinto (1990*a*). **Fauna**: 1 sp., *X. fuscum* Pinto (1990*a*), in southwestern USA and northwestern Mexico; world, 4 spp. **Hosts**: unknown, but probably Homoptera.

– *Female*: ovipositor shorter, not extending appreciably beyond apex of metasoma. *Male:* aedeagus with well developed apodemes (Fig. 74). *Both sexes:* funicle variable, 1- or 2-segmented or incompletely divided into 2 segments 30

30(29) Marginal vein densely setose (Fig. 67); funicle with 2 distinct segments .... ***Brachygrammatella*** Girault

Fauna: 1 uncommon, unidentified sp. in Mexico (Sinaloa); world, 9 spp. (see Doutt 1968, Yousuf and Shafee 1987). **Hosts**: Hemiptera and Homoptera.

– Marginal vein not as densely setose (Fig. 68); funicle 1-segmented or incompletely divided into 2 segments (Fig. 25) .... ***Chaetogramma*** Doutt

Fauna: 1 relatively common sp., *C. occidentalis* Doutt (1974), widespread, especially in western North America; world, 4 spp. [for taxonomy see Pinto (1990*a*)].

31(24) *Female*: funicle 1-segmented (Fig. 37) ....***Soikiella*** Nowicki (part)

Key: Velten and Pinto (1990). **Fauna**: 1 sp., *S. occidentalis* Velten & Pinto (1990), in western USA; world, 2 spp. **Hosts**: Asilidae.

– *Both sexes*: funicle 2-segmented (Figs. 21, 22, 26–29), although first segment sometimes short and closely appressed to second segment (Figs. 30, 31) 32

32(31) Forewing venation sigmoid, the marginal vein curving apically into elongate stigmal vein (Figs. 60, 62, 63) 33

– Forewing venation not sigmoid, the marginal vein ending abruptly at apex and stigmal vein either elongate or short and sessile (Figs. 53, 54, 59) 35

33(32) Forewing venation strongly sigmoid, the marginal vein of uneven breadth, broader at setae than between setae (Fig. 60) .... ***Poropoea*** Förster

Fauna: 1 sp., *P. attelaborum* Girault, in eastern Canada and USA; world, 10 spp. (see Subba Rao 1969). **Hosts**: Attelabidae.

– Forewing venation not as strongly sigmoid; marginal vein of similar breadth throughout (Figs. 62, 63) 34

34(33) *Both sexes*: clava with 2 distinct segments and incomplete third segment; funicle with segments each much broader than long, appearing disk-like (Fig. 21); forewing with Rs_1 .... ***Xenufens*** Girault

Fauna: 1 sp., *X. ruskini* Girault (known from females only), in USA (FL). **Hosts**: Lepidoptera.

– *Male*: clava with 3 distinct segments; funicle with segments each about as long as broad, not disk-like (Fig. 22); forewing without Rs_1 .... ***Trichogrammatoidea***, see 27

35(32) Forewing with elongate marginal setae, their maximum length at least half maximum breadth of wing; funicle with segments distinct, first segment shorter or equal in length to second segment .... ***Trichogrammatomyia*** (males, females in part), see 28

– Forewing usually with marginal setae distinctly shorter than half maximum breadth of wing or, if longer, funicle with second segment noticeably shorter than first segment 36

36(35) Funicle with first segment very short, closely appressed to second segment (Figs. 30, 31) 37

– Funicle with first segment subequal to or longer than second segment 38

37(36) Ovipositor subequal in length to metasoma or longer; protibia dorsally with 1 or more prominent spines (Fig. 71) or, if without spines, clava with prominent terminal process (as in Fig. 14); funicle with second segment subquadrate or subrectangular, usually subequal in breadth to pedicle and first claval segment (Fig. 30); marginal vein elongate, not expanded apically, distinctly longer than parastigma; stigmal vein constricted basally (Fig. 53) .... ***Chaetostricha*** Walker

Fauna: 1 described sp., *C. thanatophora* Pinto (1990*b*), and several undescribed spp, widespread; world, 20 spp. **Hosts**: Hemiptera.

– Ovipositor usually shorter, rarely subequal in length to metasoma; protibia usually without prominent spines; clava without prominent terminal process; funicle with second segment enlarged, usually broader than pedicel and first claval segment (Fig. 31); marginal vein variable but often expanding in breadth apically and shorter relative to parastigma; stigmal vein not constricted basally (Fig. 54) .... ***Zagella*** Girault

Fauna: 2 described and several undescribed spp., widespread; world, 6 spp. **Hosts**: probably Homoptera (see also Burks 1979).

38(36) Marginal vein extremely short, subquadrate, distinctly shorter than parastigma (Fig. 56) .... ***Brachyufens*** Viggiani

Note: questionably distinct from *Haeckeliania*.

Fauna: 1 described sp., *B. osborni* (Dozier), and at least 1 undescribed sp., in USA (southeastern states and CA) and Mexico. **Hosts**: Coleoptera.

– Marginal vein longer, not subquadrate, at least subequal to parastigma 39

39(38) Forewing relatively narrow, breadth at most half wing length (Figs. 43, 44); marginal vein distinctly longer than parastigma (Fig. 58); funicle with second segment usually shorter than first segment 40

– Forewing broader, often oblately broadened apically, breadth more than half wing length (Figs. 38, 41); marginal vein subequal in length to parastigma (Figs. 1, 61); funicle with second segment subequal to or longer than first segment 42

40(39) Clava 2-segmented .... ***Ittysella*** Pinto & Viggiani
Fauna: 1 sp., *I. lagunera* Pinto & Viggiani (1987), in southwestern USA and northwestern Mexico. **Hosts**: probably Homoptera.

– Clava 3-segmented 41

41(40) Funicle with segments elongate, first segment longer than broad, second segment about as long as broad (Fig. 26); forewing with Rs_1 well developed (Fig. 43) .... ***Ittys*** Girault
Fauna: 2 spp., widespread in USA and Mexico; world, 4 spp. **Hosts**: Hemiptera and Homoptera.

– Funicle with segments shorter, first segment about as broad as long, second segment transverse, distinctly broader than long (Fig. 27); forewing usually without Rs_1 (Fig. 44) .... ***Paracentrobia*** Howard (part)
Fauna: 7 spp., widespread; world, 41 spp. **Hosts**: Homoptera.

42(39) *Male*: forewing without Rs_1 (Fig. 41); stigmal vein short (Fig. 61); clava 3-segmented .... ***Soikiella***, see 31

– *Both sexes*: forewing with Rs_1 (Fig. 1); stigmal vein elongate, distinct (Fig. 1). *Male*: clava with small fourth segment (Fig. 28) 43

43(42) Stigmal vein as long as or longer than marginal vein (Fig. 1); protibia dorsally spinose; maxillary palpus 2-segmented (Fig. 5); pedicel distinctly transversely ridged, the ridges microcrenulate (Fig. 12) .... ***Mirufens*** Girault
Fauna: several undescribed spp., widespread; world, 11 spp. **Hosts**: Homoptera.

– Stigmal vein shorter than marginal vein; protibia not spinose; maxillary palpus 1-segmented (Fig. 7); pedicel relatively smooth, at most with obsolescent transverse ridges, the ridges not microcrenulate (as in Fig. 11) .... ***Ufens*** Girault
Fauna: 3 spp., widespread; world, 18 spp. **Hosts**: Homoptera.

44(1) Clava 1-segmented (Figs. 19, 20) .... ***Trichogramma***, see 14

– Clava 3-segmented 45

45(44) Funicle 1-segmented (Figs. 35, 36) .... ***Oligosita***, see 23

– Funicle 2-segmented (Fig. 27) .... ***Paracentrobia***, see 41

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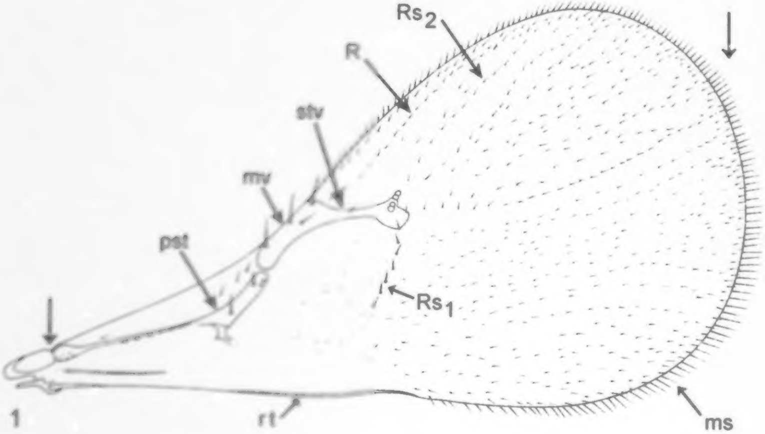
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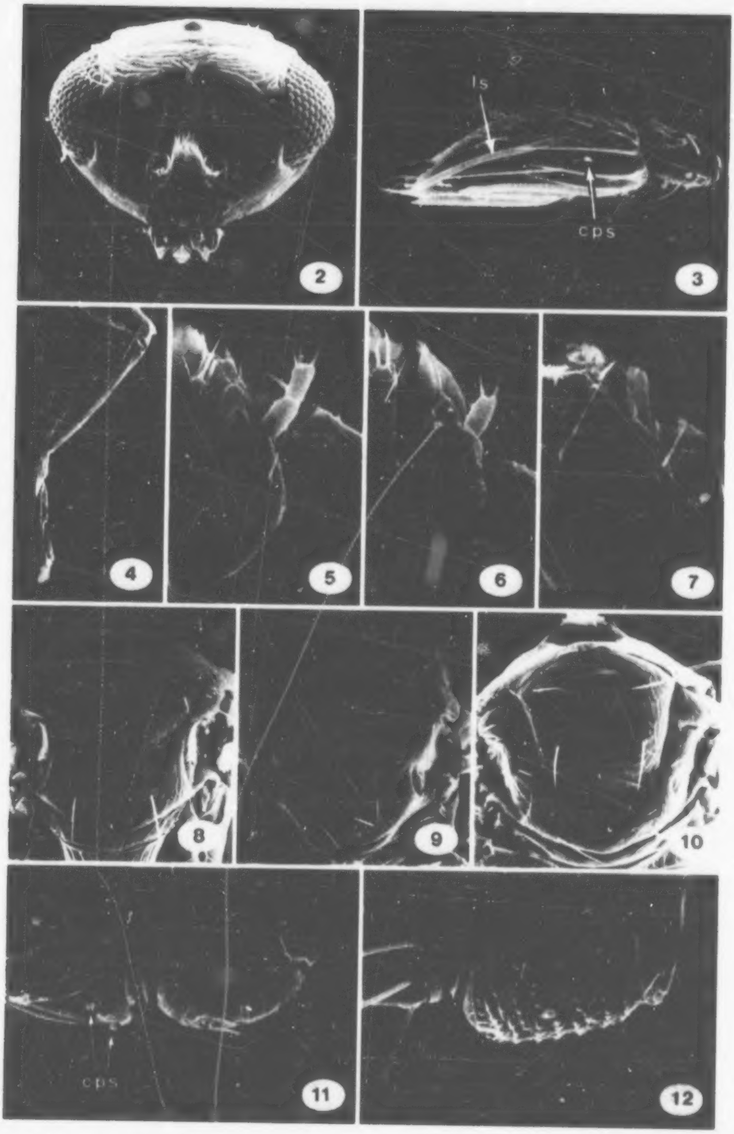
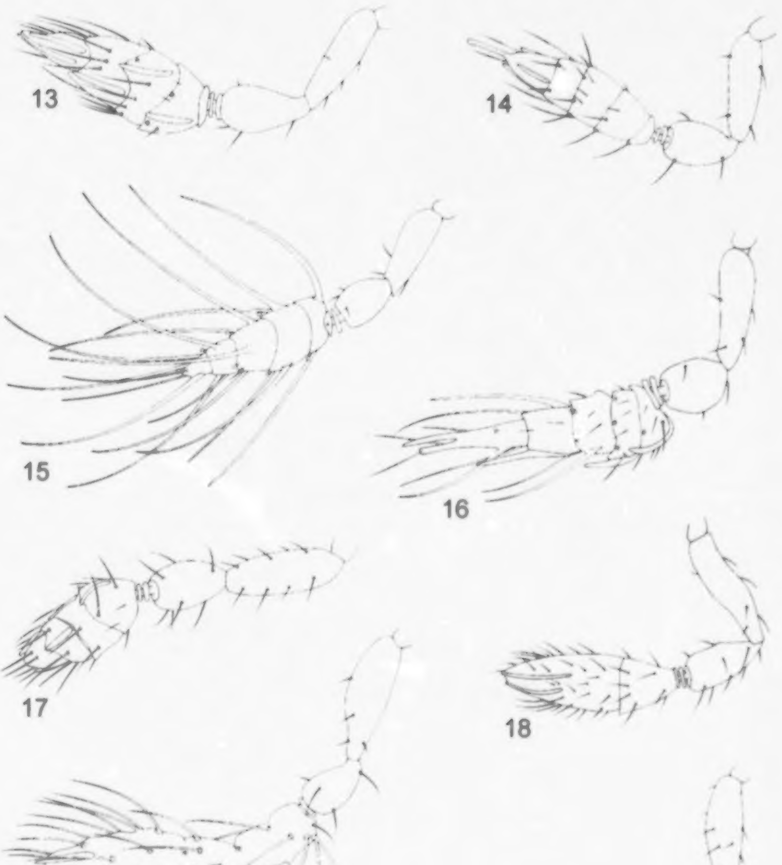
Fig. 1. ***Mirufens***, forewing, indicating structures used in key [R = radius; Rs_1, Rs_2 = radial sectors; rt = retinaculum; arrows indicate measurement of maximum forewing length].



Figs. 2–12. 2, ***Trichogramma***, head. 3, ***Trichogrammatoidea***, flagellar segments. 4, ***Trichogramma***, leg. 5–7, maxilla (ventral): 5, ***Mirufens***; 6, ***Trichogramma***; 7, ***Ufens***. 8–10, mesosoma: 8, ***Oligosita***; 9, ***Ufens***; 10, ***Trichogramma***. 11–12, base of antenna: 11, ***Ufens***; 12, ***Mirufens***.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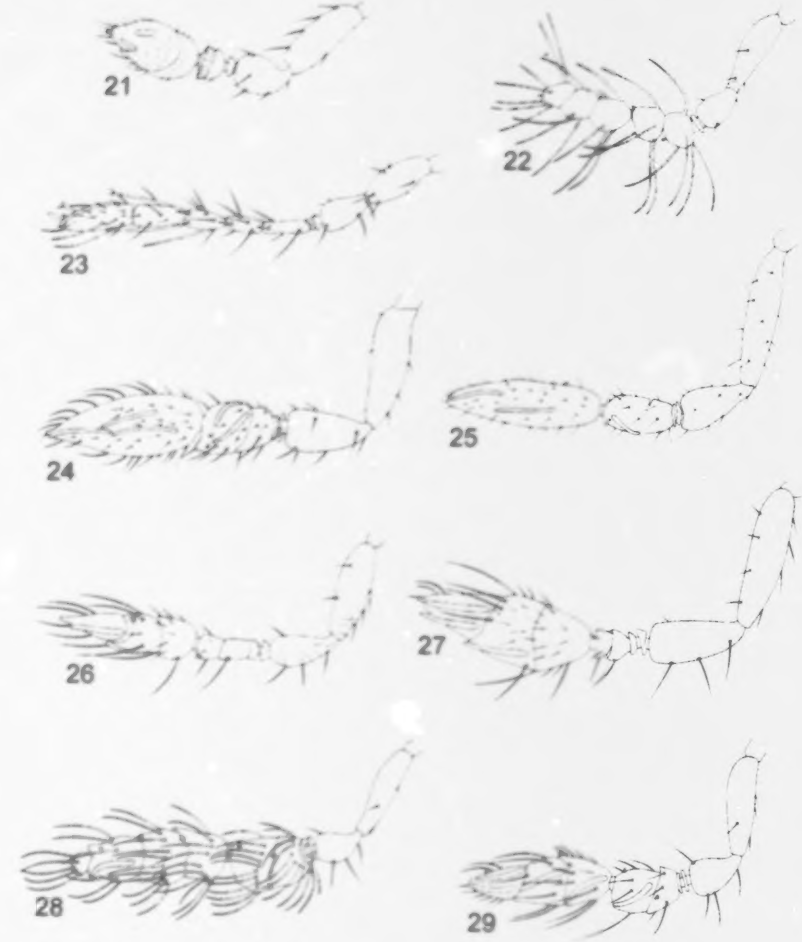
Figs. 13–20. Antenna: 13, ***Lathrogramma***; 14, ***Lathromeris***; 15, ***Haeckeliania*** ♂; 16, ***Haeckeliania*** ♀; 17, ***Brachista***; 18, ***Aphelinoidea***; 19, ***Trichogramma*** ♂; 20, ***Trichogramma*** ♀.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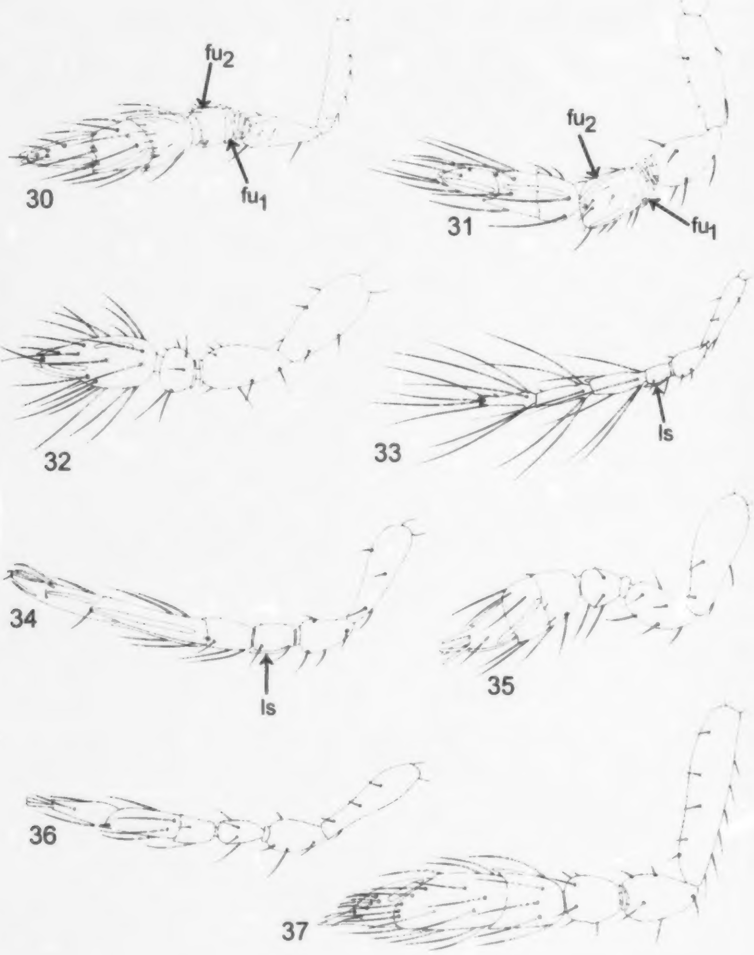
Figs. 21–29. Antenna: 21, ***Xenufens***; 22, ***Trichogrammatoidea*** ♂; 23, ***Hydrophylita***; 24, ***Xiphogramma***; 25, ***Chaetogramma***; 26, ***Ittys***; 27, ***Paracentrobia***; 28, ***Ufens*** ♂; 29, ***Ufens*** ♀.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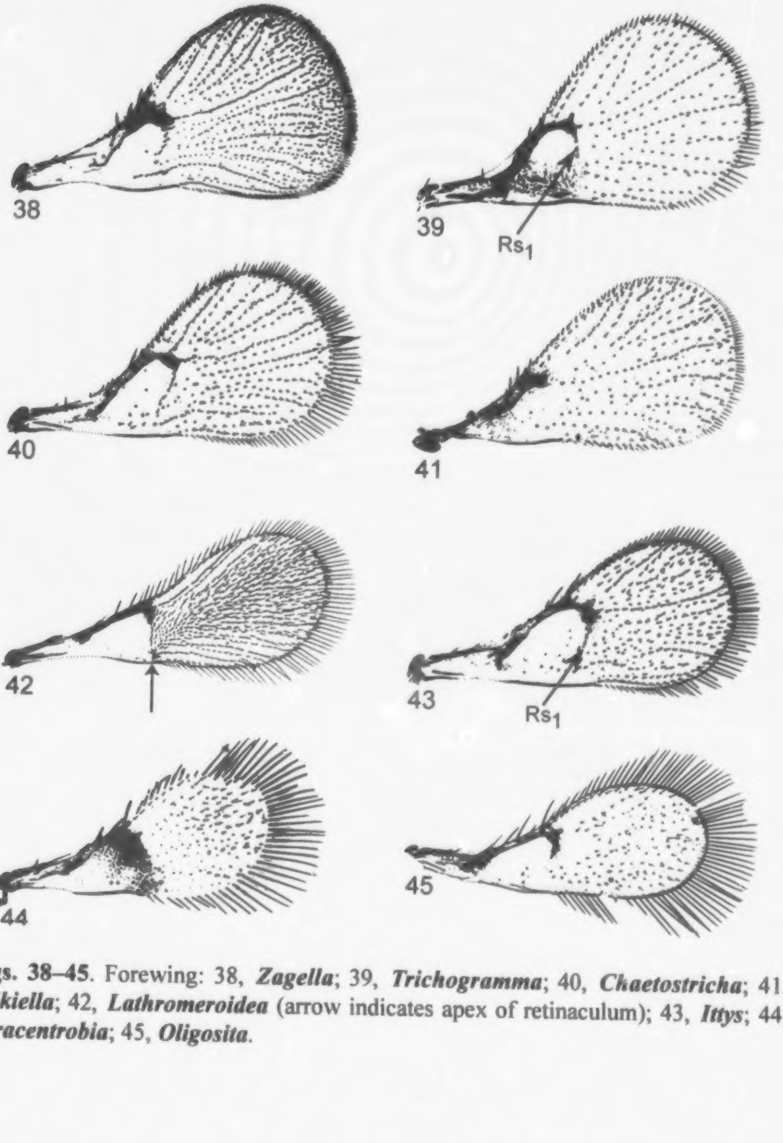
Figs. 30–37. Antenna: 30, ***Chaetostricha***; 31, ***Zagella***; 32, ***Doirania***; 33, ***Pintoa*** ♂; 34, ***Pintoa*** ♀; 35, ***Oligosita***; 36, ***Oligosita***; 37, ***Soikiella*** ♀.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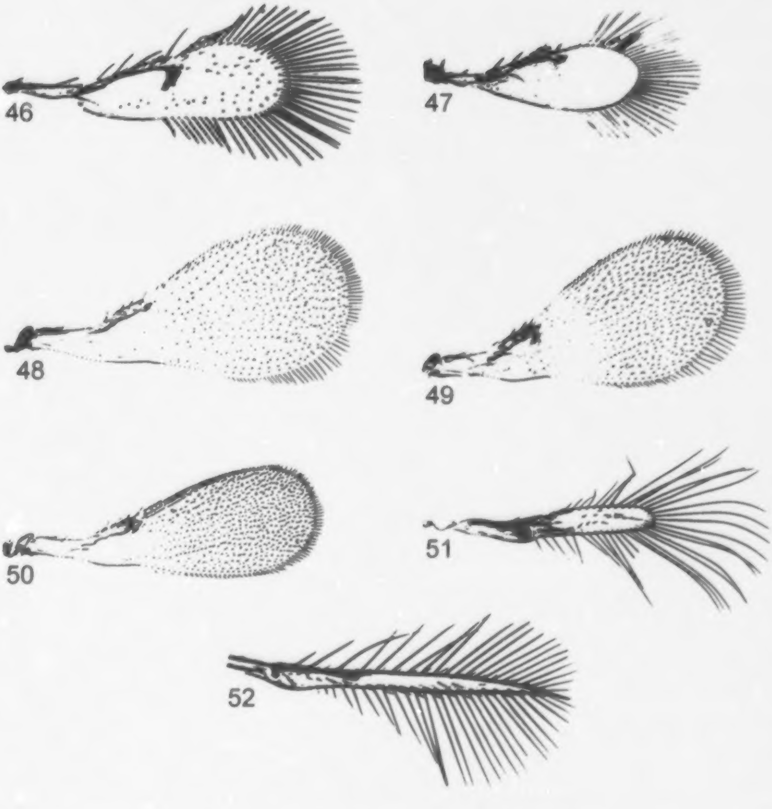
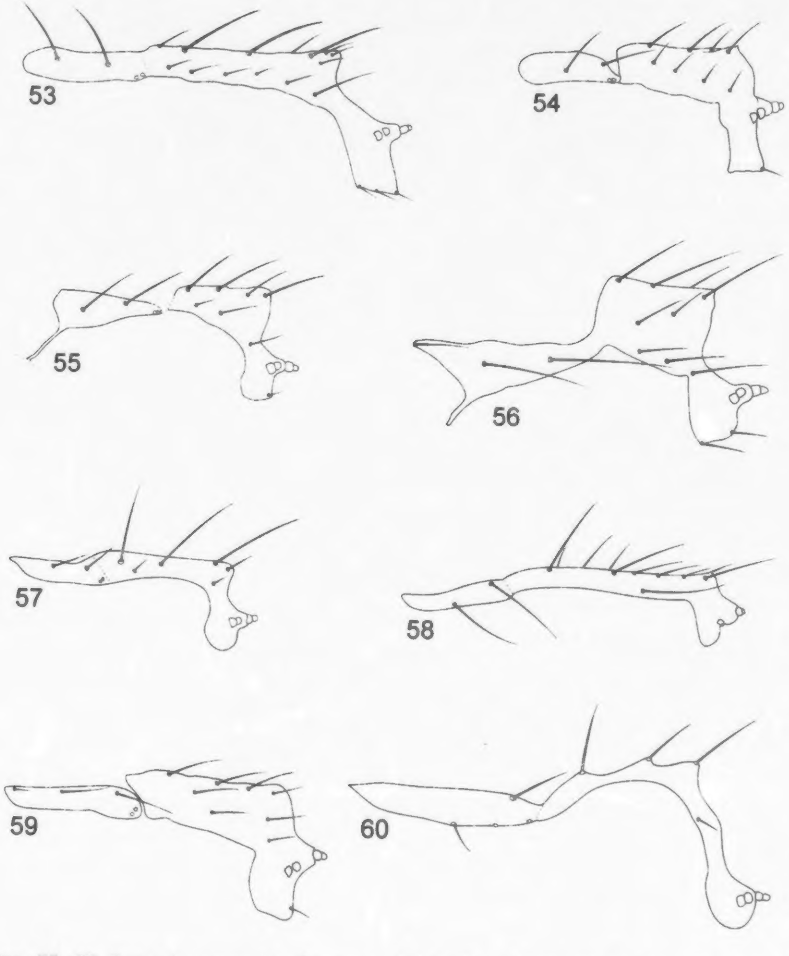
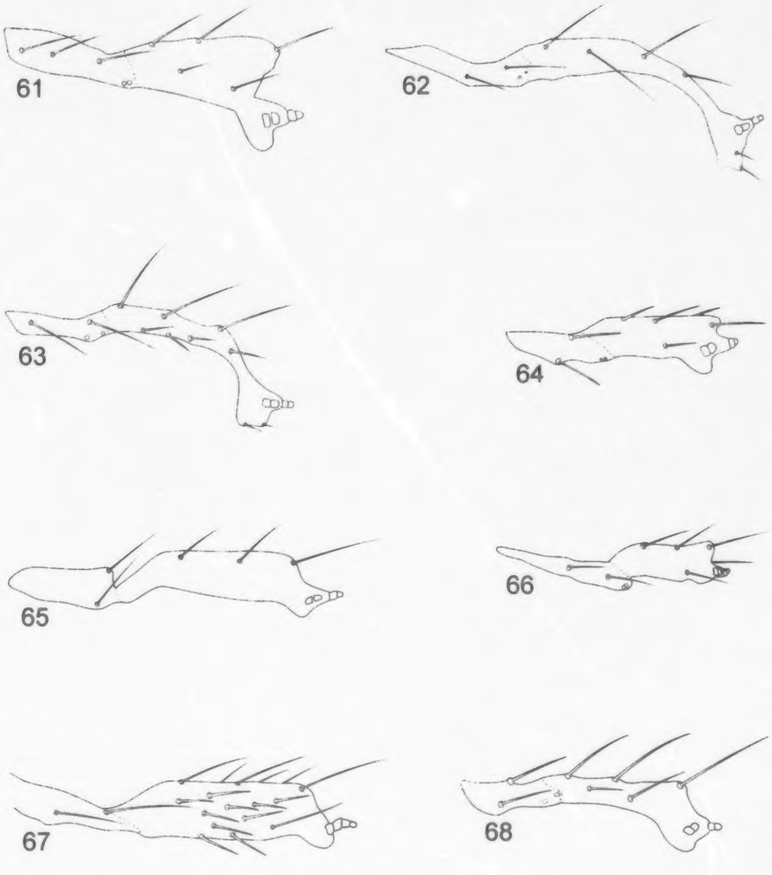
Figs. 38–45. Forewing: 38, ***Zagella***; 39, ***Trichogramma***; 40, ***Chaetostricha***; 41, ***Soikiella***; 42, ***Lathromeroidea*** (arrow indicates apex of retinaculum); 43, ***Ittys***; 44, ***Paracentrobia***; 45, ***Oligosita***.



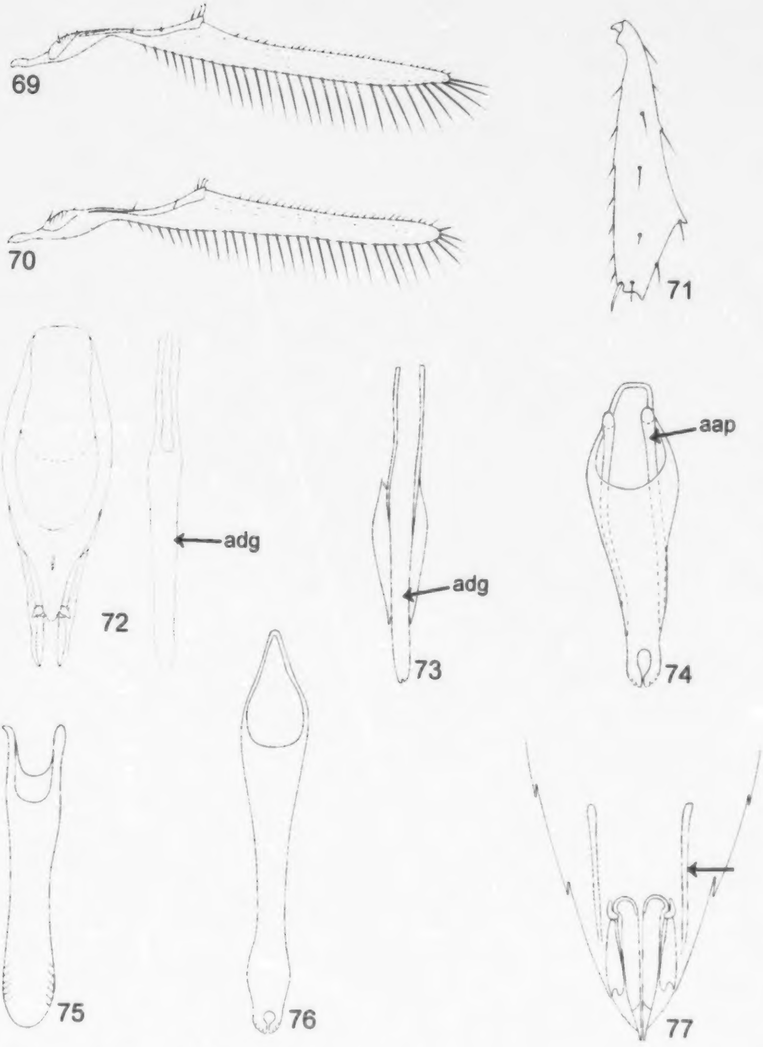
Figs. 46–52. Forewing: 46, ***Oligosita***; 47, ***Epoligosita***; 48, ***Tumidiclava***; 49, ***Aphelinoidea***; 50, ***Aphelinoidea***; 51, ***Megaphragma***; 52, ***Hydrophylita***.



Figs. 53–60. Forewing venation (apex to right): 53, ***Chaetostricha***; 54, ***Zagella***; 55, ***Haeckeliania***; 56, ***Brachyufens***; 57, ***Trichogrammatomyia***; 58, ***Paracentrobia***; 59, ***Lathrogramma***; 60, ***Poropoea***.



Figs. 61–68. Forewing venation (apex to right): 61, ***Soikiella***; 62, ***Trichogramma***; 63, ***Xenufens***; 64, ***Aphelinoidea***; 65, ***Tumidiclava***; 66, ***Paratrichogramma***; 67, ***Brachygrammatella***; 68, ***Chaetogramma***.



Figs. 69–77. 69–70, hind wing: 69, ***Aphelinoidea***; 70, ***Tamidiclava***. 71, ***Chaetostricha***, protibia. 72–76, male genitalia (dorsal): 72, ***Trichogramma*** (aedeagus removed from genital capsule); 73, ***Haeckeliania*** (aedeagus not removed from genital capsule); 74, ***Chaetogramma***; 75, ***Oligosita***; 76, ***Xiphogramma***. 77, ***Brachista***, ♀ metasomal apex (ventral) (arrow points to apodeme at base of ovipositor).

APPENDIX

This list contains about 130 generic and subgeneric names of Chalcidoidea that are listed as valid in the 1979 *Catalog of Hymenoptera in America North of Mexico* but that do not appear in the keys of this book. The first name in each line is the one that occurs in the 1979 catalog; the second name, if applicable, is the one used in the keys. The fate of the name is given followed by a reference in parenthesis where the change is proposed or confirmed.

Agaonidae

Blastophaga (*Secundeisenia* Schultz 1906) = syn. of *Pegoscapus* (Bouček 1993).
Colyostichus Mayr 1885 = syn. of *Heterandrium* (Bouček 1993).
Neosycophila Grandi 1923. Misidentification; species now under *Anidarnes bicolor* (Ashmead) and *Idarnes incerta* (Ashmead) (Bouček 1993).

Aphelinidae

Aneristus Howard 1895 = syn. of *Coccophagus* (Hayat 1983).
Archenomus Howard 1898 = syn. of *Pteroptrix* Westwood 1833 (Viggiani and Garonna 1993).
Aspidiotiphagus Howard 1894 = syn. of *Encarsia* (Viggiani and Mazzone 1979).
Azotus Howard 1898 = syn. of *Ablerus* (Hayat 1994).
Mesidia Förster 1856 = syn. of *Aphelinus* (Hayat 1983).
Physcus Howard 1895 = syn. of *Coccobius* (Hayat 1983).
Prospaltella Ashmead 1904 = syn. of *Encarsia* (Viggiani and Mazzone 1979).
Tumidiscapus Girault 1911 = syn. of *Centrodora* (Hayat 1983).

Chalcididae

Acanthochalcis (*Belochalcis* Steffan 1959). Subgenus treated as syn. of *Acanthochalcis* (Bouček 1992).
Brachymeria (*Gahanula* Burks 1960). Subgenus treated as syn. of *Brachymeria* (Bouček 1992).
Brachymeria (*Pseudobrachymeria* Burks 1960). Subgenus treated as syn. of *Brachymeria* (Bouček 1992).
Ceratosmicra Ashmead 1904 = subgenus of *Conura* (Delvare 1992).
Metadontia Ashmead 1888 = syn. of *Conura* (Delvare 1992).
Spilochalcis Thompson 1876 = subgenus of *Conura* (Delvare 1992).

Encyrtidae

Aenasioidea Girault 1911 = syn. of *Metaphycus* (Noyes and Woolley 1994).

Anabrolepis Timberlake 1920 = syn. of *Epitetracnemus* (Noyes and Hayat 1984).

Anarhopus Timberlake 1929 = syn. of *Tetracnemoidea* (Noyes 1988).

Anathrix Burks 1952 = syn. of *Apoanagyrus* (Noyes and Woolley 1994).

Anisotylus Timberlake 1919 = syn. of *Homalotylus* (Noyes and Hayat 1984).

Anusia Förster 1856. Genus extralimital. *A. neomexicana* Ashmead transferred to *Formicencyrtus* (Noyes and Woolley 1994).

Aphidencyrtus Ashmead 1900 = syn. of *Syrphophagus* (Noyes and Hayat 1984).

Aphycoideus Williams 1916 = syn. of *Aphycus* (Trjapitzin and Gordh 1978*a*).

Apterencyrtus Ashmead 1905 = syn. of *Zaomma* (Trjapitzin and Gordh 1978*a*).

Arhopoideus Girault 1915 = syn. of *Tetracnemoidea* (Trjapitzin and Gordh 1978*a*).

Calocerinus Howard 1892 = syn. of *Tetracnemus* (Noyes and Woolley 1994).

Chalcaspis Howard 1895 = syn. of *Aenasius* (Noyes and Woolley 1994).

Chestomorpha Ashmead 1900 = syn. of *Prionomastix* (Trjapitzin and Gordh 1978*a*).

Chrysopophagus Ashmead 1894 = syn. of *Cheiloneurus* (Trjapitzin and Gordh 1978*a*).

Epaenasomyia Girault 1917 = syn. of *Coelopencyrtus* (Trjapitzin and Gordh 1978*a*).

Erythraphycus Compere 1947 = syn. of *Metaphycus* (Noyes and Woolley 1994).

Euryrhopalus Howard 1898 = syn. of *Blepyrus* (Noyes and Woolley 1994).

Habrolepoidea Howard 1894. Not confirmed from region: *H. depressa* Girault transferred to *Avetianella* (Gordh and Trjapitzin 1981). *H. tarsalis* Girault treated as junior syn. of *Lamennaisia ambigua* (Nees) (Gordh and Trjapitzin 1984), and no specimens of *H. perplexa* Girault were found in USNM.

Hemaenasius Ashmead 1900 = syn. of *Pentelicus* (Noyes and Hayat 1984).

Henicopygus Ashmead 1900 = syn. of *Tetracnemus* (Noyes and Woolley 1994).

Hunterellus Howard 1908 = syn. of *Ixodiphagus* (Trjapitzin 1985).

Melanaphycus Compere 1947 = syn. of *Metaphycus* (Noyes 1980).

Nebaocharis Girault 1916 = syn. of *Tetracnemus* (Noyes and Woolley 1994).

Oobius Trjapitzin 1963. Genus extralimital: the unidentified species listed under this name is probably referable to *Avetianella* or *Szelenyiola*.

Paranusia Brèthes 1913 = syn. of *Anagyrus* (Noyes 1980).

Paraphaenodiscus Girault 1915. Misidentification: no material of this genus was seen from North America.

Parapsilophrys Howard 1898 = syn. of *Copidosoma* (Trjapitzin 1972, Noyes and Hayat 1984).

Parastenoterys Girault 1915. Genus extralimital: *P. niveiclava* Girault transferred to *Rhytidothorax* (Noyes and Woolley 1994).

Parasyrpophagus Girault 1915 = syn. of *Exoristobia* (Noyes and Hayat 1984).

Pauridia Timberlake 1919 = syn. of *Coccidoxenoides* (Noyes and Hayat 1984).

Pentacnemus Howard 1892 = syn. of *Copidosoma* (Trjapitzin and Gordh 1978*a*).

Pentalitomastix Eady 1960 = syn. of *Copidosomopsis* (Noyes and Hayat 1984).

Pheidoloxenus Ashmead 1904 = syn. of *Holcencyrtus* (Noyes and Woolley 1994).

Psilophrys Mayr 1876. Genus extralimital: *P. armata* Ashmead transferred to *Apsilophrys* (Noyes and Woolley 1994).

Quaylea Timberlake 1919 = syn. of *Coccidoctonus* (Noyes 1980).

Rhinoencyrtus Mercet 1918 = syn. of *Paratetracnemoidea* (Noyes and Hayat 1984).

Tetracnemopsis Ashmead 1900 = syn. of *Tetracnemoidea* (Trjapitzin and Gordh 1978*a*).

Tetralophidea Ashmead 1900 = syn. of *Tetracnemus* (Trjapitzin and Gordh 1978*a*).

Tetralophiellus Ashmead 1900 = syn. of *Tetracnemus* (Trjapitzin and Gordh 1978*a*).

Thysanomastix Perkins 1907 = syn. of *Hexacladia* (Trjapitzin and Gordh 1978*a*).

Timberlakia Mercet 1925 = syn. of *Pseudectroma* (Noyes and Hayat 1984).

Zeteticontus Silvestri 1915 = syn. of *Cerchysiella* (Noyes and Hayat 1984).

Eucharitidae

Stilbula Spinola 1811. Extralimital: Nearctic species transferred to *Obeza* (Heraty 1985).

Eulophidae

Achrysocharella Girault 1913 = syn. of *Closterocerus* (Hansson 1994).

Achrysocharis Girault 1913 = subgenus of *Closterocerus* (Hansson 1994).

Apterolophus Gahan 1919 = syn. of *Tetrastichomyia* (LaSalle and Schauff 1990).

Ardalus Howard 1897 = syn. of *Elachertus* (Boucek 1988).

Burksia Fullaway 1955 = syn. of *Neotrichoporoides* (Graham 1987).

Chrysocharomyia Dodd 1915 = syn. of *Omphale* (Boucek 1988).

Cirrospiloideus Ashmead 1904 = syn. of *Elachertus* (Schauff and LaSalle 1993).

Diaulomorpha Ashmead 1900. Extralimital: the single Nearctic species transferred to *Dicladocerus* (Schauff and LaSalle 1993).

Emersonopsis Girault 1917 = syn. of *Paracrias* (Schauff 1985).

Enaysma Delucchi 1954 = syn. of *Achrysocharoides* (Yoshimoto 1977).

Euophthalmomyia Ashmead 1904 = syn. of *Chrysocharis* (Yoshimoto 1973).

Flockiella Timberlake 1957 = syn. of *Quadrastichodella* (Bouček 1977).

Giraultia Gahan & Fagan 1923 = replacement name for *Cirrospilopsis* Girault 1915 = syn. of *Cirrospilus* (Bouček 1988).

Hypertetrastichus Moser 1965 = syn. of *Pentastichus* (LaSalle 1994).

Lophocomus Haliday 1843. Extralimital subgenus of *Bellerus* (De Santis 1966).

Mirolynx Girault 1916 = syn. of *Aulogymnus* (Schauff and LaSalle 1993).

Mirzagrammosoma Girault 1915 = syn. of *Zagrammosoma* (LaSalle 1989).

Moserina Delucchi 1962 = syn. of *Omphale* (Schauff 1991).

Nesomyia Ashmead 1904 = syn. of *Chrysocharis* (Kamijo 1976).

Notanisomorpha Ashmead 1904 = syn. of *Hemiptarsenus* (Schauff and LaSalle 1993).

Omphalomopsis Girault 1917 = syn. of *Aprostocetus* (LaSalle 1994).

Parachrysocharis Girault 1913. Misidentification; the only included species is extralimital (LaSalle and Schauff 1990).

Pardiaulomella Girault 1915 = syn. of *Sympiesis* (Bouček 1988).

Prothymus Girault 1917 = syn. of *Aprostocetus* (LaSalle 1994).

Pseudolynx Girault 1916 = syn. of *Aulogymnus* (Schauff and LaSalle 1993).

Rhicnopeltoidea Girault 1917 = syn. of *Chrysocharis* (Hansson 1987).

Rhicnopeltomyia Girault 1913 = syn. of *Chrysonotomyia* (Bouček 1988).

Syntomosphyrum Förster 1878 = syn. of *Aprostocetus* (Graham 1961).

Thriposoma Crawford 1913 = syn. of *Baryscapus* (LaSalle and Graham 1990).

Thymus Girault 1916. Unrecognizable and unplaced (LaSalle 1994).

Winnemana Crawford 1911 = syn. of *Cirrospilus* (Graham 1975).

Eupelmidae

Encyrtaspis Ashmead 1904 = syn. of *Arachnophaga* (*Idoleupelmus*) (Gibson 1995).

Eupelmella Masi 1919 = syn. of *Eupelmus* (*Macroneura*) (Gibson 1995).

Merostenus Walker 1837. Extralimital; one species introduced for biocontrol but not established.

Eurytomidae

Eudecatoma Ashmead 1888 = syn. of *Sycophila* (Bouček 1974).

Gahaniola Erdös 1952 = syn. of *Tetramesa* (Zerova 1976).

Harmolita Motschulsky 1863 = syn. of *Tetramesa* (Claridge 1958).

Mymaridae

Barypolynema Ogloblin 1946 = syn. of *Polynema* (Schauff 1984).

Cosmocomoidea Howard 1908 = syn. of *Gonatocerus* (Ogloblin 1959, Schauff 1984), treated as subgenus (Ogloblin 1959).

Paracleruchus Yoshimoto 1971 = syn. of *Cleruchus* (Viggiani 1974).

Parallelaptera Enock 1909 = syn. of *Erythmelus* (Schauff 1984).

Patasson Walker 1846 = syn. of *Anaphes*; treated as subgenus by Debauche (1948) and species group of *Anaphes* by Huber (1992).

Ormyridae

Monobaeus Förster 1860 = syn. of *Ormyrus* (Mayr 1904).

Pteromalidae

Apterolelaps Ashmead 1904 = syn. of *Dipara* (Heydon and Bouček 1992).

Bairamlia Waterston 1929. Misidentification (Heydon and Bouček 1992).

Beloneura Ashmead 1896 = syn. of *Urolepis* (Heydon 1994).

Chalcedectus Walker 1852. Misidentification; Nearctic species belong in either *Dryadochalcis* or *Amotura* (Bouček 1988. Grissell 1991).

Choetospila Westwood 1874 = syn. of *Theocolax* (Bouček 1988).

Colotrechnus (*Zanonia* Masi 1921). Subgenus treated as syn. of *Colotrechnus* (Graham 1969).

Euchrysia Westwood 1874. Misidentification; North American species belong to *Amotura* (Grissell 1991).

Eupteromalus Kurdjumov 1913 = syn. of *Trichomalopsis* (Kamijo and Grissell 1982).

Habrocytus Thomson 1878. Regarded as barely of subgeneric value under *Pteromalus* (Bouček and Graham 1978).

Karpinskiella Bouček 1955 = syn. of *Tomicobia* (Bouček 1991).

Lonchetron Graham 1956. Misidentification; genus delimited to include only two European species (Graham 1969). The only North American species transferred to *Eulonchetron* (Heydon and Bouček 1992).

Lophocomodia Ashmead 1888 = syn. of *Psilocera* (Heydon and Bouček 1992).

Megatrydymus Girault 1917 = syn. of *Acaenacis* (Heydon and Bouček 1992).

Paradibrachys Girault 1917 = syn. of *Pseudocatolaccus* (Grissell 1985).

Parasyntomocera Girault 1917 = syn. of *Gastrancistrus* (Heydon and Bouček 1992).

Parecrizotes Girault 1916 = syn. of *Gastrancistrus* (Heydon and Bouček 1992).

Pirene Haliday 1833 = syn. of *Macroglenes* (Graham 1969).

Ptinobius Ashmead 1895 = syn. of *Cleonymus* (Bouček 1988).

Stigmatocrepis Ashmead 1904 = syn. of *Gastrancistrus* (Heydon and Bouček 1992).

Theocolaxia Girault 1924 = syn. of *Neocalosoter* (Bouček 1988).

Trimeromicrus Gahan 1914 = syn of *Lyrcus*; type species first transferred to *Zatropis* (Heydon and Bouček 1992) and then *Zatropis* synonymized under *Lyrcus* (Bouček 1993*b*).

Trimicrops Kieffer 1906 = syn. of *Alloterra* Kieffer 1904 (Dessart 1996).

Zatropis Crawford 1908 = syn. of *Lyrcus* (Bouček 1993*b*).

Torymidae

Antistrophoplex Crawford 1914 = syn. of *Microdontomerus* (Grissell in Bouček 1982).

Dimeromicrus Crawford 1910 = syn. of *Torymoides* (Bouček 1988).

Eumegastigmus Hussey 1956 = syn. of *Megastigmus* (Bouček 1978).

Liodontomerus Gahan 1914 = syn. of *Idiomacromerus* (Grissell 1995).

Trichogrammatidae

Giraultiola Nowicky 1936 = syn. of *Brachista* (Pinto 1993).

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INDEX TO PLANT HOSTS AND ASSOCIATES

Family names of plants are given only when the plant is indeed the host of a phytophagous chalcidoid, not simply an associate, that is, one on which a chalcidoid is collected or on which it's insect host occurs.

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[1] Familial and ordinal names follow Borrer, D.J., C.A. Triplehorn, and N.F. Johnson. 1989. An introduction to the study of insects, 6th edition. Saunders College Publishing. Philadelphia. 875 pp.

As an aid to non-specialists, common names are included for economically important host species, as listed in Stoetzel, M.B. (Chairman). 1989. Common names of insects and related organisms. Entomological Society of America, Washington, DC. 199 pp.

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